8691A
8692A
8693A
8694A
RF UNITS

INCLUDING H01, H02 MODELS

OPERATING AND SERVICE MANUAL

HP 8691A SERIES

OPERATING AND SERVICE MANUAL

MODELS
8691A
8692A
8693A
8694A

INCLUDING H01, H02 MODELS

RF UNITS

SERIALS PREFIXED: 620-

02334-1

Printed: JULY 1966

TABLE OF CONTENTS

Section	Title	Page
I	GENERAL INFORMATION	1-1
1-1.	Description	1-1
1-4.	Instrument Identification	1-1
1-6.	Installation	1-2
1-8.	Operation	1-2
1-10.	Principles of Operation	1-2
II	MAINTENANCE	2-1
2-1.	Introduction	2-1
2-3.	Performance Tests	2-1
2-5.	Troubleshooting	2-1
2-7.	Detailed Component Maintenance	2-1
2-9.	Directional Detector Repair	2-1
II	Maintenance (Cont' d)	
2-11.	BWO Tube Replacement	2-2
2-12.	Warranty	2-2
2-14.	Ordering a Replacement BWO Tube	2-2
2-16.	BWO Tube Removal	2-2
2-17.	BWO Tube Installation	2-2
2-20.	Adjustment	2-3
III	REPLACEABLE PARTS	3-1
3-1.	Introduction	3-1
3-3.	Ordering Information	3-1
IV	SCHEMATIC DIAGRAMS	4-1
4-1.	Introduction	4-1
Appendix I	Directional Detectors 786D/787D/788C	

LIST OF ILLUSTRATIONS

Number	Title	Page
1-1.	Typical 8691A-8694A RF Unit	1-0
1-2.	Front and Rear Panel Controls, Connectors, and Indicators	1-3
2-1.	Maintenance Setup Number 1	2-3
2-2.	Maintenance Setup Number 2	2-4
2-3.	Maintenance Setup Number 3	2-6
2-4.	Component Identification, Interior Left Side	2-7
2-5.	Component and Adjustment Identification, Interior Top View	2-8
2-6.	Component Identification Assembly A1	2-9
2-7.	Waveforms	2-9
2-8.	Component Identification, Assemblies A2, A3	2-10
4-1.	Schematic Diagram Notes	4-1
4-2.	RF Unit	4-3
4-3.	Output Configurations	4-5

LIST OF TABLES

Number	Title	Page
1-1.	Specifications	1-1
2-1.	Test Equipment Required for Maintenance	2-1
2-2.	Maximum BWO Currents, mA	2-2
2-3.	Adjustments	2-3
3-1.	Reference Designation Index	3-2
3-2.	Replaceable Parts	3-7
3-3.	Code List of Manufacturers	3-9

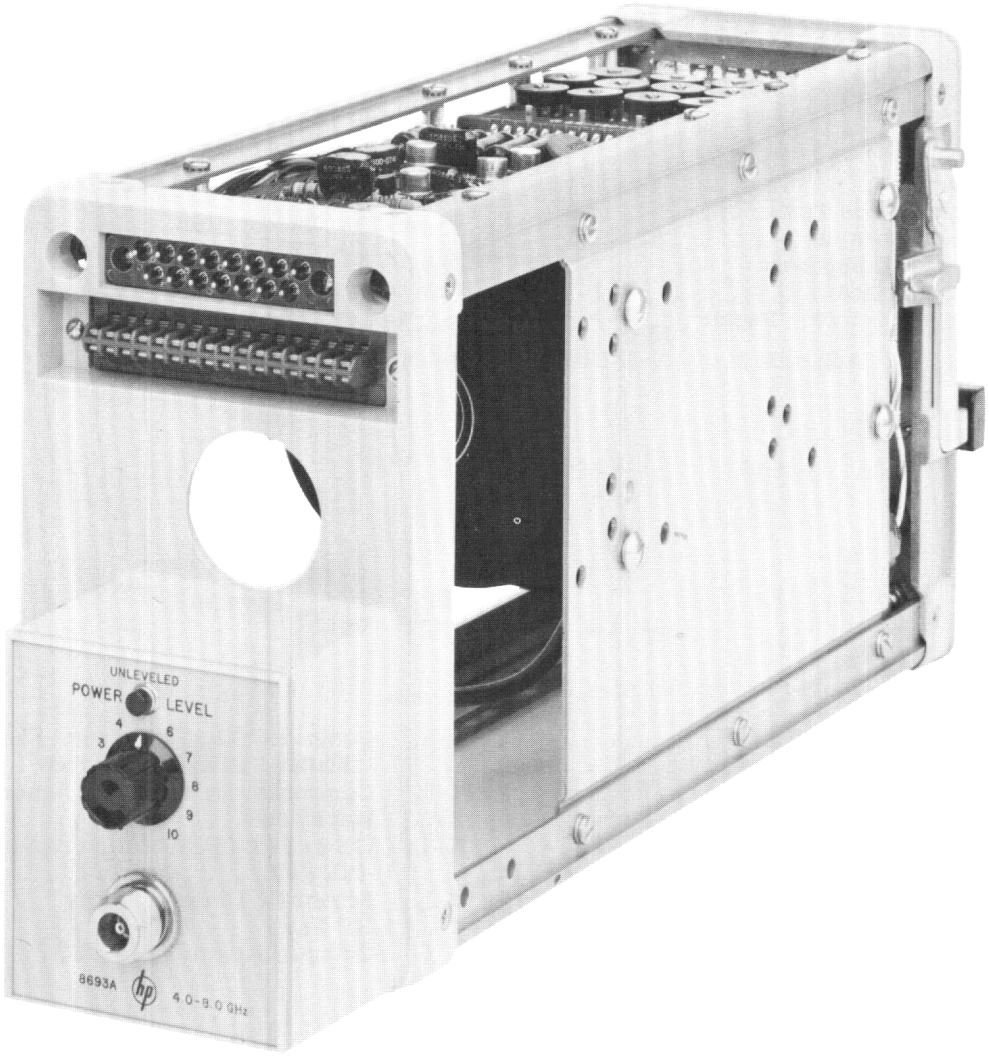


Figure 1-1. Typical 8691A-8694A RF Unit

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Model 8691A through 8694A RF Units, including H01 and H02 Models, combine with the 8690A Sweep Oscillator to form an electronically tuned microwave signal source with a frequency range of 1 GHz to 12.4 GHz. Individual RF Unit Model specifications are given in Table 1-1.

1-3. The 8691A - 8694A RF Units are grid modulated by circuits included within the RF Unit, and have coaxial RF output. Option 01 RF Units contain an internal leveling loop. Internal leveling allows the Sweep Oscillator - RF Unit combination to automatically hold amplitude constant as output frequency changes.

1-4. INSTRUMENT IDENTIFICATION.

1-5. Each Sweep Oscillator carries a two-section, eight-digit serial number (000-00000) of which the first three digits are a prefix. The contents of this manual apply to those RF Units having the serial number prefix(es) listed on the title page. Revisions required to

Table 1-1. Specifications

Residual AM: At least 40 dB below CW output.

Spurious Signals: Harmonics, at least 20 dB below CW output; non-harmonics, at least 40 dB below CW output.

Reference Output: Direct-coupled voltage proportional to RF frequency, approximately 0 v at the low end of the band, increasing approximately 40 v/octave. Output impedance, 30,000 ohms.

Leveling Indicator: Front-panel indicator lights when power level set too high to permit leveling over entire selected sweep range or when operating in unleveled mode.

Equivalent Source Match:

Externally Leveled: Depends upon coupler.

Unleveled: Less than 2.5:1.

Power Variation, Unleveled: Less than 10 dB over the entire band.

Weight:

8691A, 8692A: Net, 17 lbs. (7,6 kg). Shipping, 25 lbs. (11,3 kg).

8693A, 8694A: Net, 10 lbs. (4,5 kg). Shipping, 18 lbs. (8,1 kg).

Furnished: 8690A dial scale corresponding to frequency range of RF Unit.

MODEL 8691A RF UNIT
(Installed in 8690A Sweep Oscillator)

Frequency Range: 1 to 2 GHz

Frequency Accuracy (over $\geq$ 6-dB range): ±1%

Maximum Leveled Power: At least 100 mW

RF Power Control: BWO Grid

Frequency Stability:
With Temperature: ±0.01%/°C
With 10% Change in Line Voltage: ±500 kHz
With 10-dB Power Level Change: typically ±20 MHz
Residual FM: < 30 kHz peak

Power Variation, External Leveling*: ±0.2 dB.

Output Impedance and/or Connector: 50 ohms/Type N

Option 01 Internal Leveling:

Power Variation: ±0.4 dB

Equivalent Source Match: 1.13:1

MODEL 8692A RF UNIT
(Installed in 8690A Sweep Oscillator)

Frequency Range: 2 to 4 GHz

Frequency Accuracy (over $\geq$ 6-dB range): ±1%

Maximum Leveled Power: At least 70 mW

RF Power Control: BWO Grid

Frequency Stability:
With Temperature: ±0.01%/°C
With 10% Change in Line Voltage: ±500 kHz
With 10-dB Power Level Change: typically ±40 MHz
Residual FM: < 30 kHz peak

Power Variation, External Leveling*: ±0.2 dB

Output Impedance and/or Connector: 50 ohms/Type N

Option 01 Internal Leveling:
Power Variation: ±0.4 dB
Equivalent Source Match: 1.16:1

Table 1-1. Specifications (Continued)

MODEL 8693A RF UNIT
(Installed in 8690A Sweep Oscillator)

Frequency Range: 4 to 8 GHz

Frequency Accuracy (over ≥ 6-dB range): ±1%

Maximum Leveled Power: At least 30 mW

RF Power Control: BWO grid

Frequency Stability:
With Temperature: ±0.01%/°C
With 10% Change in Line Voltage: ±1 MHz
With 10-dB Power Level Change: typically ±80 MHz
Residual FM: < 50 kHz peak

Power Variation, External Leveling*: ±0.2 dB

Output Impedance and/or Connector: 50 ohms/Type N

Option 01 Internal Leveling:
Power Variation (into matched load): ±0.5 dB
Equivalent Source Match (approx): 1.25:1

MODELS 8694A, H01-8694A, H02-8694A RF UNITS
(Installed in 8690A Sweep Oscillator)

	8694A	H01-8694A	H02-8694A
Frequency Range	8 to 12.4 GHz	7 to 12.4 GHz	7 to 11 GHz
Frequency Accuracy (over ≥ 6-dB range)	±1%	±1%	±1%
Maximum Leveled Power	At least 50 mW	At least 25 mW	At least 25 mW
RF Power Control	BWO grid	BWO grid	BWO grid
Frequency Stability			
With Temperature	±0.01%/°C	±0.01%/°C	±0.01%/°C
With 10% Change in Line Voltage	±1 MHz	±1 MHz	±1 MHz
Residual FM	< 50 kHz peak	< 50 kHz peak	< 50 kHz peak
Power Variation, External Leveling*	±0.2 dB	±0.2 dB	±0.2 dB
Output Impedance and/or Connector	50 ohms/Type N	50 ohms/Type N	50 ohms/Type N
Option 01 Internal Leveling			
Power Variation (into matched load)	±1.0 dB	±1.0 dB	±1.0 dB
Equivalent Source Match (approx.)	2:1	2:1	2:1

*Excluding coupler and detector variation.

adapt this manual to serial number prefixes not listed on the title page are contained in a yellow-sheet Manual Changes insert supplied with the manual. For information concerning serial number prefixes not listed either on the title page or in an insert, contact one of the Hewlett-Packard sales and service offices listed at the rear of this manual.

1-6. INSTALLATION.

1-7. The RF Unit is designed to be installed into the 8690A Sweep Oscillator from the rear. To install the RF Unit, perform the following steps:

a. Push the plastic retaining catch inward to release the handle on the rear of the RF Unit.

b. Raise the RF Unit handle 90 degrees to a position perpendicular to the RF Unit rear panel.

c. Gently push the RF Unit into the 8690A Sweep Oscillator from the rear.

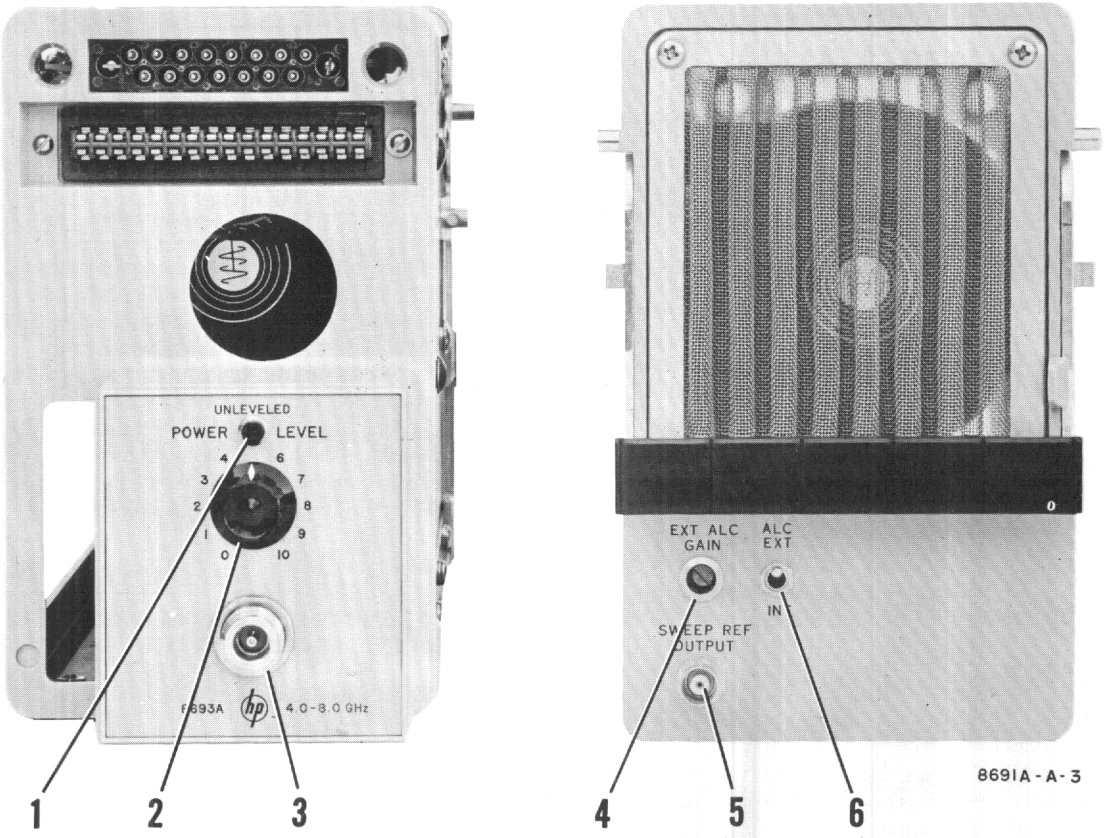
d. Return the RF Unit handle to the locked position, in line with the RF Unit rear panel. This step should firmly secure the RF Unit into the 8690A Sweep Oscillator.

1-8. OPERATION.

1-9. Operating procedures of the Sweep Oscillator-RF Unit combinations are given in the 8690A Sweep Oscillator Manual. Figure 1-2 shows the front and rear views of a typical 8691A-8694A RF Unit. Front and rear panel controls, connectors and indicators are described in Figure 1-2.

1-10. PRINCIPLES OF OPERATION.

1-11. Principles of circuit operation of the Sweep Oscillator - RF Unit combinations are given in the 8690A Sweep Oscillator Manual. Circuit functions included in the RF Unit are: (1) microwave signal generation by the backward wave oscillator (BWO) tube, (2) BWO anode voltage and shaping for proper BWO currents, (3) BWO helix voltage shaping for frequency accuracy, (4) grid modulation, (5) unleveled lamp control, and (6) internal leveling in Option 01 Models.



1. UNLEVELED. Lights if POWER LEVEL set too high for leveling across selected frequency range.

2. POWER LEVEL. Adjust RF power amplitude.

3. RF Output Connector. Standard 50-ohm type N connector except on Option 01 Models which have hp precision 50-ohm type N connectors.

   CAUTION

   Do not couple hp precision connectors.

4. EXT ALC GAIN. Adjust gain of ALC circuit to control flatness of leveling.

5. SWEEP REF OUTPUT. Output voltage proportional to RF frequency.

   CAUTION

   Application of voltage greater than ±15volts may damage transistor A1Q1.

6. ALC EXT-INT. Switch installed on Option 01 RF Units. Selects or disables an internal leveling loop.

Figure 1-2. Front and Rear Panel Controls, Connectors, and Indicators

SECTION II
MAINTENANCE

2-1. INTRODUCTION.

2-2. This section provides adjustment procedures for the circuits included within the RF Unit. In addition, procedures for BWO replacement and the required electrical adjustments after replacement are given. Test equipment required for RF Unit maintenance is listed in Table 2-1.

2-3. PERFORMANCE TESTS.

2-4. Front panel controlled performance tests in the 8690A Sweep Oscillator Manual include tests of the RF Unit electrical specifications given in Table 1-1. If the electrical performance of the Sweep Oscillator-RF Unit combination fails to meet any of the specifications listed in Table 1-1, and a circuit malfunction is not suspected, refer to the adjustment paragraphs. If substandard performance occurs, and a circuit malfunction is suspected, refer to the troubleshooting paragraphs in the 8690A Sweep Oscillator Manual.

2-5. TROUBLESHOOTING.

2-6. Complete troubleshooting procedures for all Sweep Oscillator-RF Unit combinations are included in the 8690A Sweep Oscillator Manual. Where applicable, these troubleshooting procedures analyze the circuit functions contained in the RF Unit. If a circuit malfunction has occured in the RF Unit, sufficient detailed information is provided at that point in the troubleshooting analysis to define the smallest functional circuit block that contains the malfunctioning circuit. Appropriate references are then made to this Manual.

2-7. DETAILED COMPONENT MAINTENANCE.

2-8. Information on etched circuit board repair, including component, transistor, and tube socket replacement, and etched conductor repair is given in the maintenance section of the 8690A Sweep Oscillator Manual.

2-9. DIRECTIONAL DETECTOR REPAIR.

2-10. Instructions for repairing the Directional Detector Assembly A4 in the Option 01 RF Units are contained in the Operating Note included as Appendix I in this manual.

Table 2-1. Test Equipment Required for Maintenance

Instrument	Critical Specifications	Recommended Models
Oscilloscope	Vertical Bandwidth: 5 MHz Vertical Sensitivity: 5 mV/cm Sweep Time Accuracy: ±3%	hp 140 with 1402 and 1420 Plug-Ins hp 175 with 1752 Plug-In
Crystal Detector	Frequency Range: Same as RF Unit used Sensitivity: 100 mV dc from < 0.35 mW, high level; > 0.4 mV dc/μW, low level Frequency Response: ±0.5 dB or better	hp 423
Fixed Attenuator	Frequency Range: Same as RF Unit used Attenuation: nominal 10 dB nominal 20 dB	hp 8491 Option 10: 10 dB Option 20: 20 dB
Frequency Meter	Frequency Range: Same as RF Unit used Accuracy: ±0.1%	hp 536 hp 537
Power Meter and Thermistor Mount	Frequency Range: Same as RF Unit used Power Range: 1μW to 10 mW	hp 431 with hp 478 and hp 486
Waveguide-to-Coaxial Adapter	Frequency Range: Same as RF Unit used	hp H281, X281
DC Voltmeter	Range: 0 to ±300V Accuracy: ±0.2% minimum Input Impedance: 10 megohms	hp 405BR hp 3440/3441
Clip-On DC Ammeter	Range: 10 mA to 5 amps Accuracy: ±5%	hp 428

2-11. BWO TUBE REPLACEMENT.

2-12. WARRANTY.

2-13. BWO tube V1 is not manufactured by Hewlett-Packard and therefore is not covered by the Sweep Oscillator warranty. A separate, manufacturer's warranty covers the BWO tube. Both Watkins-Johnson Company (Stewart Division) and Varian BWO tubes are warranted for heater operation of 2500 hours, or one year, whichever occurs first. If the BWO tube fails within this warranty period, see the Warranty Claim and Adjustment Procedure at the rear of this manual. Always detach and return Time Meter A3M1 when returning a BWO tube for warranty adjustment.

2-14. ORDERING A REPLACEMENT BWO TUBE.

2-15. When ordering a replacement BWO tube from Hewlett-Packard order, in addition, a replacement Time Meter (A3M1). See Paragraph 3-6.

2-16. BWO TUBE REMOVAL.

a. Disconnect Sweep Oscillator from AC line power.

b. Remove RF Unit.

c. Disconnect BWO tube RF Output. Watkins-Johnson (Stewart) BWO tubes are equipped with impedance-matching balun units attached to the two white RF output leads. The balun consists of a brass-colored assembly and a flanged female-to-female type N adapter. IMPORTANT: Do not disassemble the balun unit or detach the adapter from the balun. Both units are part of the BWO tube and must be included with a BWO tube returned for warranty adjustment. New and replacement BWO tubes are supplied with a balun and adapter attached.

d. Disconnect BWO tube leads from terminal assembly A3.

e. Remove 4 screws fastening BWO tube to chassis. (Detach and save aluminum mounting blocks.)

f. Remove BWO tube.

2-17. BWO TUBE INSTALLATION.

2-18. MECHANICAL.

a. Be sure Sweep Oscillator is disconnected from AC line power.

b. Bolt two aluminum mounting blocks to BWO so bolt heads are recessed in countersunk holes. Tighten bolts securely.

c. Bolt BWO tube to RF Unit chassis. Tighten mounting bolts.

d. Connect BWO tube RF output as originally connected.

e. Install replacement Time Meter (A3M1) on A3 etched circuit, locating timing gap over time scale zero line.

2-19. ELECTRICAL ADJUSTMENTS.

a. Before connecting BWO tube leads to A3 assembly adjust anode voltage as follows:

(1) Set Sweep Oscillator for CW (single-frequency) operation at some frequency above the middle of the RF tuning range.
(2) Measure anode voltage at Test Point 2, on Assembly A3, and adjust A1R42, Anode Adjust, to give anode voltage within ±5 volts of the operating value on the BWO tube label.

b. Disconnect Sweep Oscillator from AC line power; then connect BWO tube leads to appropriate A3 terminals. (Use tube data sheet to identify leads.)

c. Install RF Unit and Turn on Sweep Oscillator and allow a few minutes for the BWO tube to reach operating temperature.

d. Set Sweep Oscillator for CW operation at the highest frequency in the RF tuning range. Set POWER LEVEL for maximum output.

e. Measure BWO tube anode voltage at Test Point 2, on Assembly A3, and monitor current in BWO tube cathode lead using clip-on DC Ammeter (Table 2-1). Adjust A1R42, Anode Adjust, to obtain top frequency cathode current specified on tube data sheet.

f. Equalize RF power output over tuning range as follows:

(1) Connect equipment as in Figure 2-1. Omit connection to Power Meter Level Input. Obtain CW operation and set POWER LEVEL to MAX CW. Set Sweep Oscillator for CW operation, and POWER LEVEL for maximum output.
(2) Measuring current in BWO tube cathode and helix leads, tune RF output to frequency in lower half of RF tuning range at which RF output is minimum. Adjust A1R40, ANODE SHAPE ADJ for maximum RF output without exceeding maximum cathode and helix currents specified in Table 2-2.

Note

Excessive helix current actuates 8690A Helix Over-current relay K3, starting a sequence which disconnects BWO operating voltages. To reconnect voltages, set LINE to OFF, then back to RF and wait for time delay to recycle.

Table 2-2. Maximum BWO Currents, mA

RF Unit Model	Watkins-Johnson		Varian		
	Helix	Cathode	Helix	Cathode	Anode
8691A	4.0	17.0			
8692A	3.5	15.0			
8693A	3.0	12.0	30.0	42.0	10.0
8694A	3.0	12.0	30.0	42.0	10.0
H01-8694A	3.0	12.0	30.0	42.0	10.0
H02-8694A	3.0	12.0	30.0	42.0	10.0

(3) Manually tune through the full band checking that neither cathode nor helix current exceeds the maximum values listed in Table 2-2. If maximum values are exceeded, radjust A1R42, ANODE ADJ, and/or A1R40, ANODE SHAPE ADJ, to reduce current. ANODE SHAPE ADJ affects lower half of RF tuning range; ANODE ADJ affects full band.

(4) Repeat steps (2) and (3) to obtain best full-band RF power flatness within the current limits specified in Table 2-2.

g. Perform the adjustment procedures given in Table 2-3, except for the Crystal ALC Leveled Output Adjustment.

2-20. ADJUSTMENT.

2-21. The adjustment procedures given in Table 2-3 are to be performed in order listed, and should only be made with the RF Unit installed in an 8690A Sweep Oscillator known to be accurately calibrated. Accurate 8690A Sweep Oscillator calibration can be ensured by performing the adjustment procedures listed in the Sweep Oscillator Manual. If an adjustment requirement cannot be satisfied, refer to the troubleshooting paragraphs in the 8690A Sweep Oscillator Manual.

2-22. ADJUSTMENT CONTROL SETTINGS. Unless otherwise specified, set the 8690A Sweep Oscillator controls for all adjustments as follows:

LINE . . . . . RF
START/CW
MARKER 1 - START/CW
MARKER 2 - STOP
STOP/ΔF
} Low end of specified range, any RF Unit
SWEEP SELECTOR . . . . . CW
FUNCTION pushbuttons . . . . . All Released
AMPLITUDE MOD pushbuttons . . . . All Released
ALC . . . . . Released
MANUAL SWEEP . . . . . MAX CCW
SWEEP TIME (SEC) 100-10
VERNIER . . . . . LINE SYNC
INT SQ WAVE FREQ . . . . . MAX CCW
BLANKING . . . . . OFF
PWR MTR LEVEL . . . . . OFF
ALL BNC INPUTS and OUTPUTS . . . No connection

Table 2-3. Adjustments

1. ANODE VOLTAGE.

Procedure

a. Ensure that RF Unit is properly installed in 8690A.

b. Set 8690A controls as follows:
FUNCTION . . . . . START-STOP
SWEEP SELECTOR . . . . . CW
START/CW . . . High end of specified range

c. Set RF Unit POWER LEVEL control to MAX CW.

d. Connect 3440 Voltmeter (Table 2-1) from Test Point 2 on Terminal Assembly A3 to 8690A chassis ground.

e. Adjust A1R42, ANODE ADJUST, for the voltage shown on the BWO tube label.

f. Perform ANODE SHAPING and BWO CURRENTS adjustment procedures.

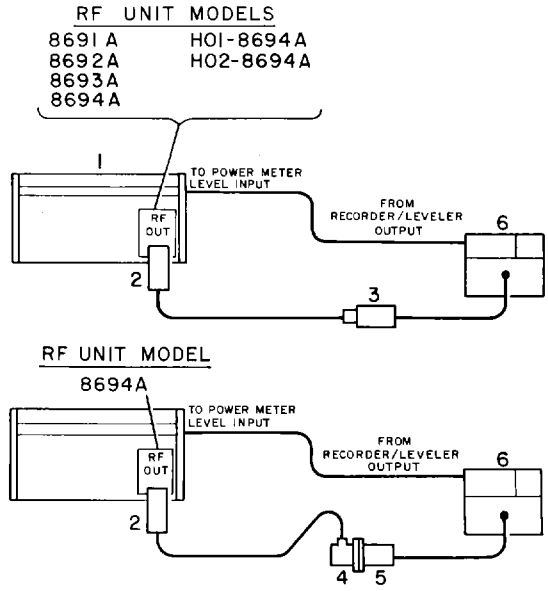
2. ANODE SHAPING.

Procedure

a. Enusre that RF Unit is properly installed in 8690A.

b. Set 8690A controls as follows:
FUNCTION . . . . . START-STOP
SWEEP SELECTOR . . . . . CW
ALC . . . . . Depressed
PWR MTR LEVEL . . . . . ON
START/CW . . . Low end of specified range

c. Connect equipment as shown in Figure 2-1, according to RF Unit used.



1. SWEEP OSCILLATOR *hp* 8690A
2. ATTENUATOR *hp* 8491 - As required to reduce power to thermistor mount to less than 10 mW
3. THERMISTOR MOUNT *hp* 478
4. COAXIAL TO WAVEGUIDE ADAPTER *hp* X281
5. THERMISTOR MOUNT *hp* X486
6. POWER METER *hp* 431

8691A-8-1

Figure 2-1. Maintenance Setup Number 1

Table 2-3. Adjustments (Cont' d)

d. Measure leveled power output. If power level is not at least the appropriate minimum level tabulated below, proceed to step e.

RF Unit Model	Power Level, dBm
8691A	20.0
8692A	18.5
8693A	14.8
8694A	17.0
H01-8694A	14.0
H02-8694A	14.0

e. Adjust A1R40, ANODE SHAPE ADJ, to achieve the appropriate power output specified in step d. Do not adjust A1R40 ANODE SHAPE ADJUST, unless necessary.

3. BWO CURRENTS.

Procedure

a. Ensure that RF Unit is properly installed in 8690A.

b. Set 8690A controls as follows:
FUNCTION . . . . . START-STOP
SWEEP SELECTOR. . . . . .CW
START/CW . . Low end of specified range

c. Connect 428 DC Ammeter (Table 2-1) clip-on probe around BWO helix lead (red).

d. Measure helix current with START/CW at low end of specified range; then at high end of specified range.

e. If low or high end current is greater than specified in Table 2-2, adjust A1R42, ANODE ADJUST, to bring current within limits.

f. Perform ANODE SHAPING adjustment procedure, and steps a through e of BWO CURRENTS adjustment procedure until further adjustments are not required.

g. On Watkins-Johnson BWO, connect 428 DC Ammeter clip-on probe around cathode lead (yellow). On Varian BWO, connect 428 DC Ammeter clip-on probe around anode lead (blue).

h. Measure cathode (Watkins-Johnson BWO) or anode (Varian BWO) current with START/CW at low end of specified range; then at high end of specified range.

i. Repeat steps e and f.

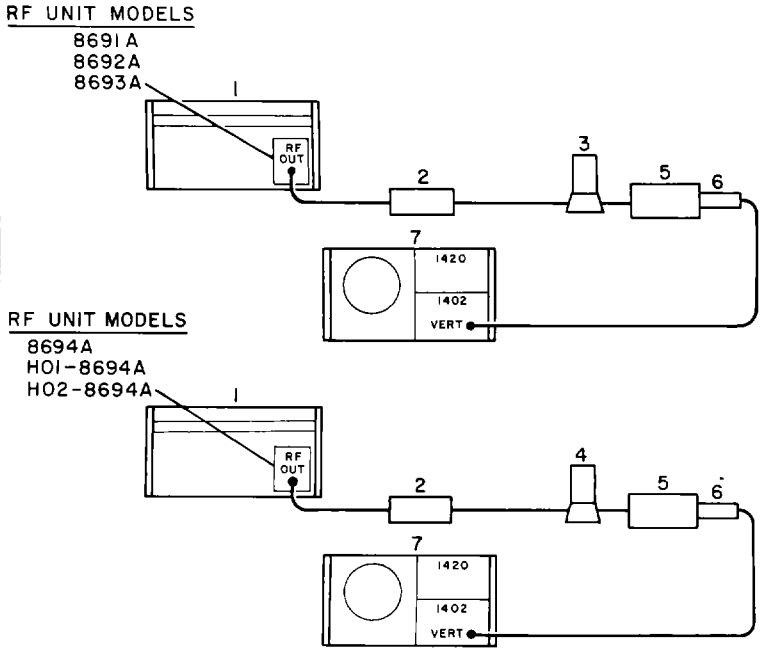
4. HELIX VOLTAGE SHAPING.

Procedure

a. Ensure that RF Unit is properly installed in 8690A.

b. Set 8690A controls as follows:
FUNCTION . . . . . ΔF
SWEEP SELECTOR . . . . . .MANUAL
STOP/ΔF. . . . . .MAX CW

c. Connect 3440 Voltmeter (Table 2-1) from Test Point 4 on 8690A Helix Amplifier Assembly A4 to 8690A chassis ground.



NOTE

1. Use the appropriate equipment

RF UNIT	FREQUENCY METER
8691A	*hp* 536
8692A	536
8693A	537
H01-8694A	537
H02-8694A	537

1. SWEEP OSCILLATOR *hp* 8690A
2. ATTENUATOR *hp* 8491 - As required to reduce power to Crystal Detector to less than 100mW
3. FREQUENCY METER (Refer to Note 1)
4. FREQUENCY METER *hp* 537
5. CRYSTAL DETECTOR *hp* 423
6. 100 OHM LOAD RESISTOR *hp* 11523 (*hp* 422, 423, 424 Option 02)
7. OSCILLOSCOPE *hp* 140

8691A-8-2

Figure 2-2. Maintenance Setup Number 2

Table 2-3. Adjustments (Cont' d)

d. Set START/CW and MANUAL SWEEP for 69.5 Vdc at Test Point 4 on 8690A Assembly A4.

e. Adjust A1R24, SHAPE ADJ, on "A" Modulator Assembly A1, for approximately 0.0 Vdc across A1CR3.

f. Connect equipment as shown in Figure 2-2.

g. Set START/CW and MANUAL SWEEP for 3.00 ±0.01 Vdc at Test Point 4 on 8690A Assembly A4.

h. Adjust A2R13, on Freq Shape Assembly A2, for low end frequency of specified range. Use frequency meter and oscilloscope display to determine frequency setting.

i. Set START/CW and MANUAL SWEEP for 38.00 ±0.01 Vdc at Test Point 4 on 8690A Assembly A4.

j. Adjust A2R12, on Freq Shape Assembly A2, for midpoint frequency of specified range. Use frequency meter and oscilloscope display to determine frequency setting.

k. Repeat steps g through j until adjustments are not necessary.

l. Set START/CW and MANUAL SWEEP for 73.00 ±0.01 Vdc at Test Point 4 on 8690A Assembly A4.

m. Adjust A1R24, SHAPE ADJ, on "A" Modulator Assembly A1, for high end frequency of specified range.

5. FREQUENCY ACCURACY.

Procedure

a. Ensure that RF Unit is properly installed in 8690A.

b. Set 8690A controls as follows:

FUNCTION . . . . . .ΔF
SWEEP SELECTOR . . . . . .MANUAL
STOP/ΔF. . . . . .MAX CW

c. Connect equipment as shown in Figure 2-2.

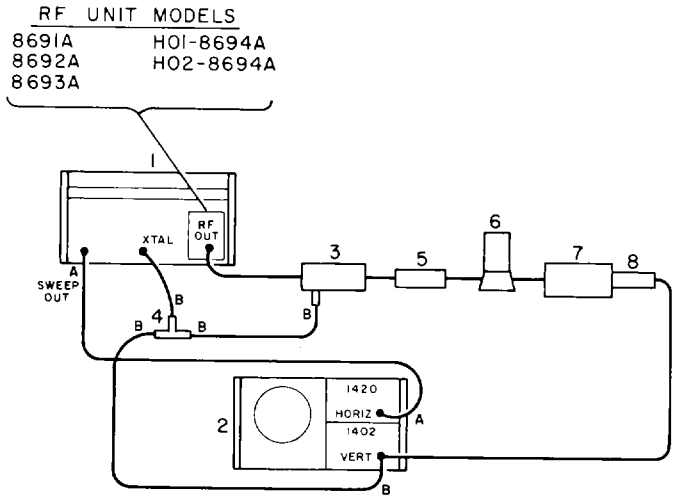
d. Connect 3440 Voltmeter (Table 2-1) from Test Point 4 on 8690A Helix Amplifier Assembly A4 to 8690A chassis ground.

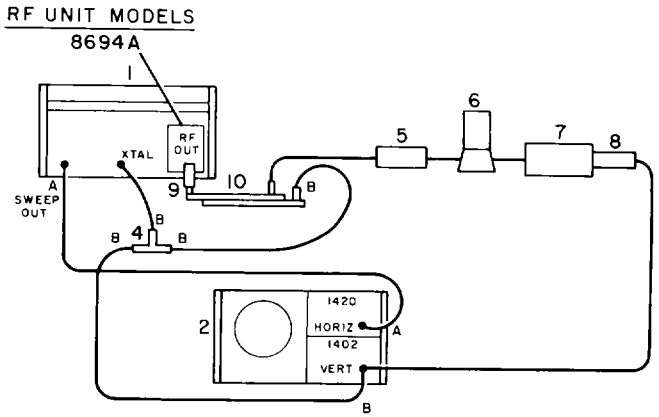
e. Set START/CW and MANUAL SWEEP for voltages at Test Point 4 on 8690A Assembly A4 as listed in step g, according to RF Unit used.

f. Determine RF output frequency using frequency meter and oscilloscope display. Frequency accuracy test limits are given in step g.

g. If necessary, set frequency of RF output by compromise adjustment of A1R24, SHAPE ADJ, A2R12, and A2R13.

Vdc at Test Point 4, 8690A Assembly A4	Frequency (GHz) 8691A	8692A	8693A	8694A	H01-8694A	H02-8694A
73.00 ± 0.01	2.000	4.000	8.000	12.40	12.40	11.00
66.00 ± 0.01	1.900	3.800	7.600	11.96	11.86	10.60
59.00 ± 0.01	1.800	3.600	7.200	11.52	11.32	10.20
52.00 ± 0.01	1.700	3.400	6.800	11.08	10.78	9.800
45.00 ± 0.01	1.600	3.200	6.400	10.64	10.24	9.400
38.00 ± 0.01	1.500	3.000	6.000	10.20	9.700	9.000
31.00 ± 0.01	1.400	2.800	5.600	9.760	9.160	8.600
24.00 ± 0.01	1.300	2.600	5.200	9.320	8.620	8.200
17.00 ± 0.01	1.200	2.400	4.800	8.880	8.080	7.800
10.00 ± 0.01	1.100	2.200	4.400	8.440	7.540	7.400
3.00 ± 0.01	1.000	2.000	4.000	8.000	7.000	7.000
TEST LIMIT (%)	±0.8	±0.8	±0.8	±0.8	±0.8	±0.8





NOTE

1. Use the appropriate equipment

RF UNIT	DIRECTIONAL DETECTOR	FREQUENCY METER
8691A	*hp* 786	*hp* 536
8692A	787	536
8693A	788	537
H01-8694A	Narda 22440 with *hp*423 Crystal Detector	537
H02-8694A		537
8694A		537

1. SWEEP OSCILLATOR *hp* 8690A
2. OSCILLOSCOPE *hp* 140
3. DIRECTIONAL DETECTOR (Refer to Note 1)
4. BNC TEE CONNECTOR
5. ATTENUATOR *hp* 8491, As required to reduce power to Crystal Detector to less than 100mW
6. FREQUENCY METER (Refer to Note 1)
7. CRYSTAL DETECTOR *hp* 423
8. 100 OHM LOAD RESISTOR *hp* 11523 (*hp* 422,423,424 Option 02)
9. MALE N to MALE N ADAPTER
10. DIRECTIONAL DETECTOR *hp* 789 (Refer to Note 1)

8691A-C-1

Figure 2-3. Maintenance Setup Number 3

Table 2-3. Adjustments (Cont' d)

6. BWO GRID LEVEL.

Procedure

a. Ensure that RF Unit is properly installed in 8690A.

b. Set 8690A controls as follows:

FUNCTION . . . . . .START-STOP
SWEEP SELECTOR . . . . . AUTO
START/CW. . . Low end of specified range
STOP/ΔF. . . . High end of specified range
AMPLITUDE MOD. . . . . .INT SQ WAVE
SWEEP TIME (SEC) . . . . . .01 SEC

c. Set RF Unit POWER LEVEL control to MAX CW.

d. Connect equipment as shown in Figure 2-2. Connect 8690A SWEEP OUT to horizontal input of oscilloscope.

e. Adjust A1R14, GRID LEVEL ADJ, so power output is off during the negative going portion of the square wave modulation signal acorss the specified range. The display base line should approximate a straight line.

7. CRYSTAL ALC LEVELED OUTPUT.

Procedure

a. Ensure that RF Unit is properly installed in 8690A.

b. Connect equipment as shown in Figure 2-3. Omit connection C and connection B from BNC tee connector to vertical input of oscilloscope.

c. Set 8690A controls as follows:

SWEEP SELECTOR . . . . . AUTO
START/CW. . . Low end of specified range
STOP/ΔF. . . . High end of specified range
ALC . . . . . Depressed
PWR MTR LEVEL. . . . . .OFF
ALC EXT-INT (Option 01 Units). . . . INT
SWEEP TIME (SEC) . . Suitable for display

d. Observe detected power on oscilloscope display.

e. Adjust A1R1, LEVEL SHUNT, so that the maximum RF power output portion of the display curve just begins to level off.

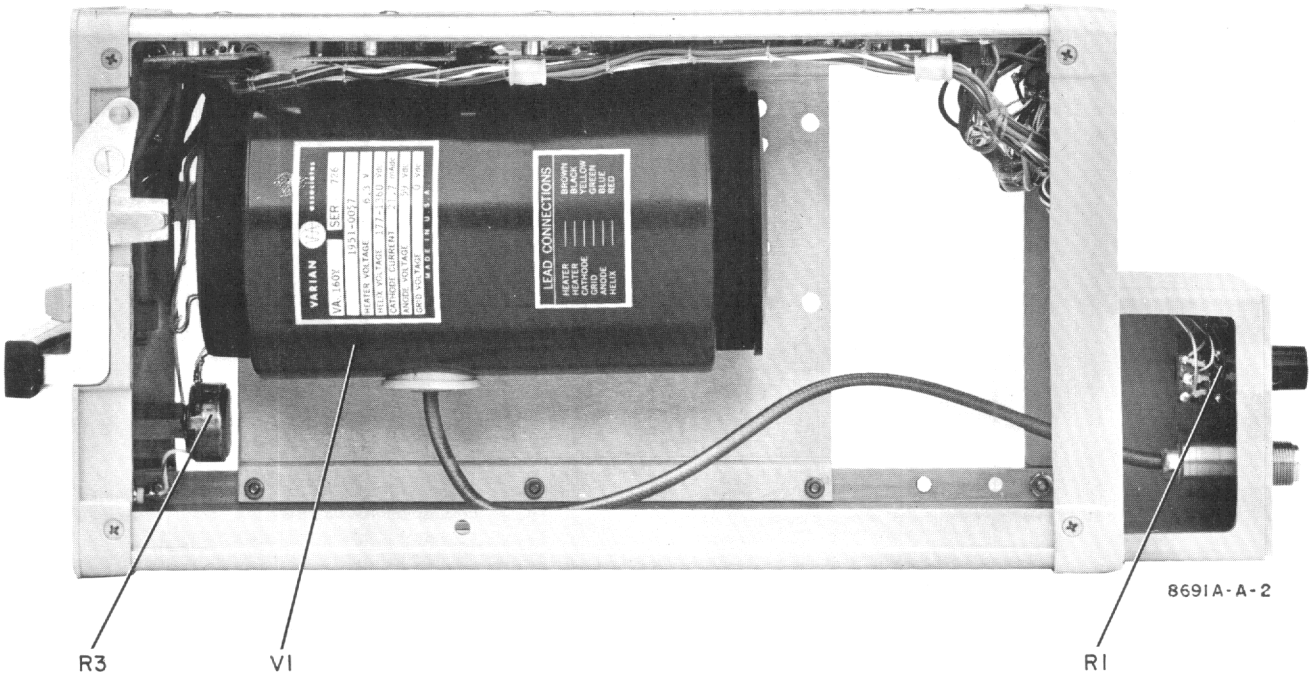


Figure 2-4. Component Identification, Interior Left Side

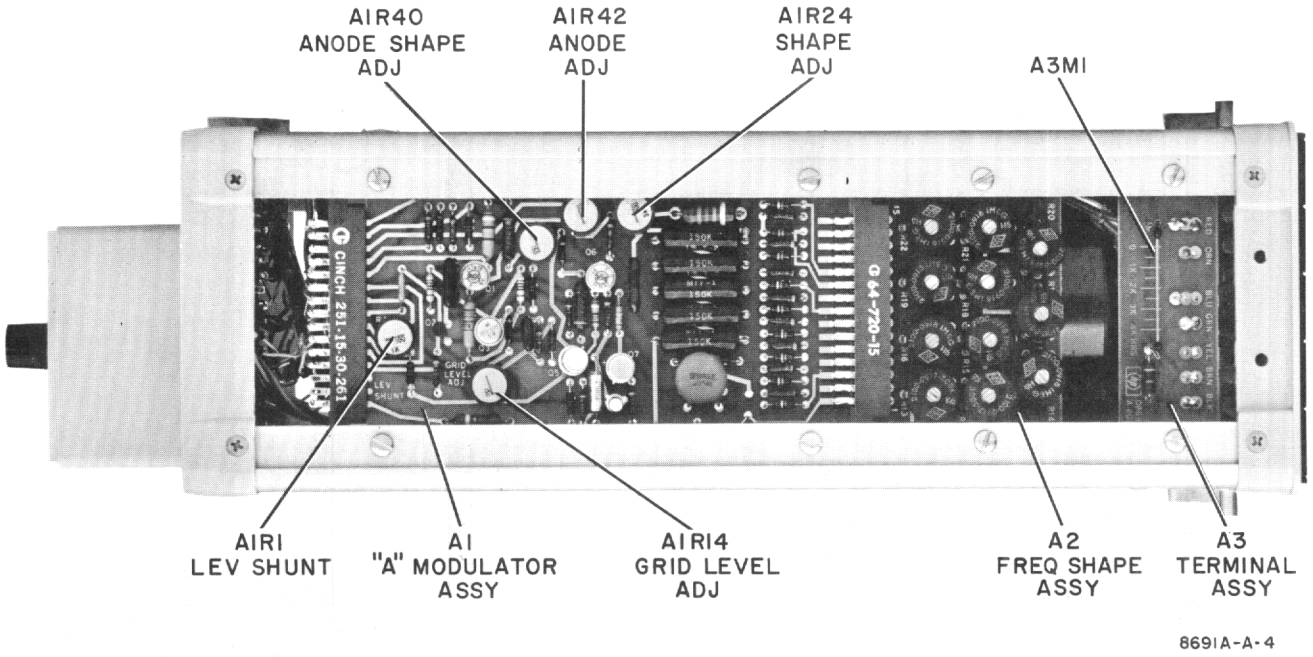


Figure 2-5. Component and Adjustment Identification, Interior Top View

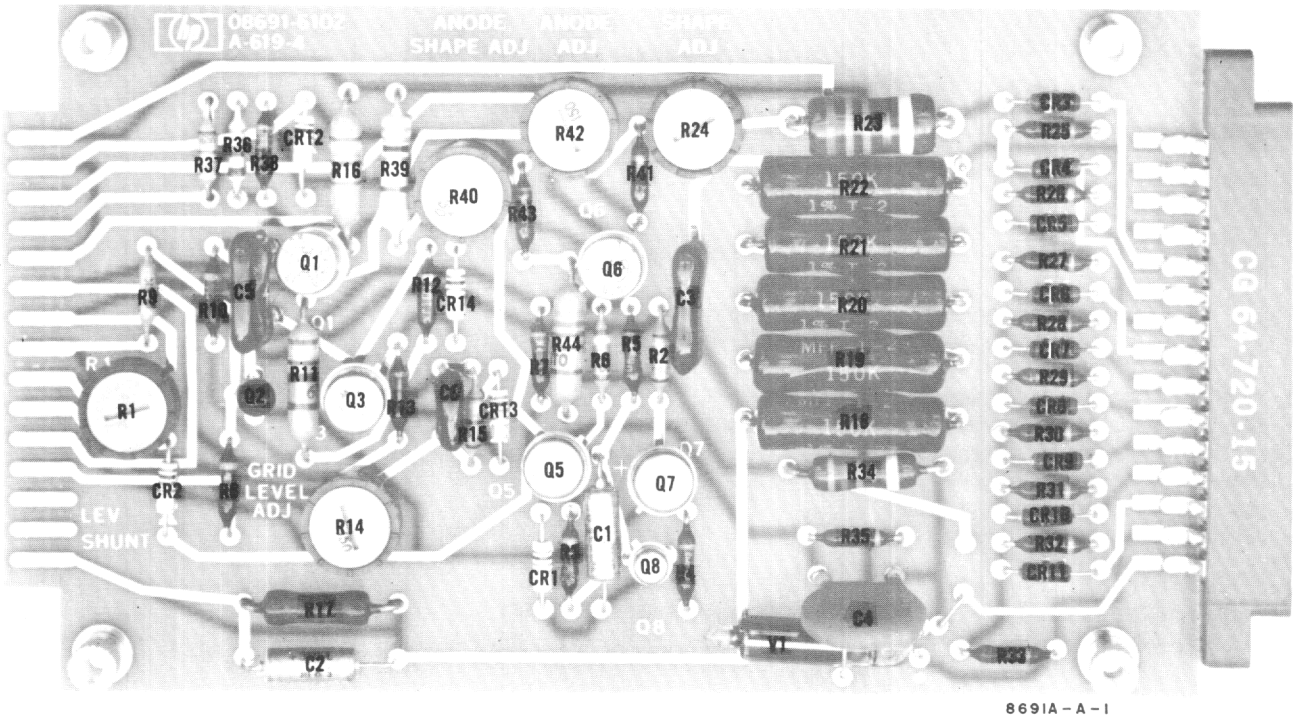
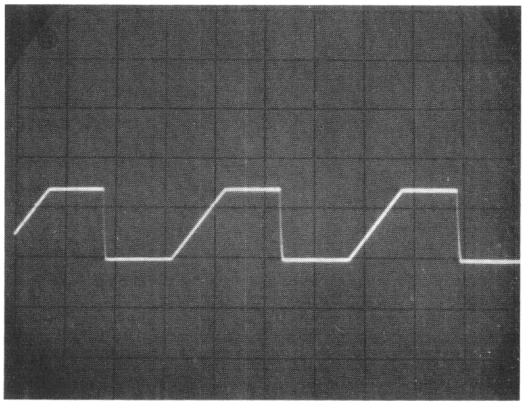
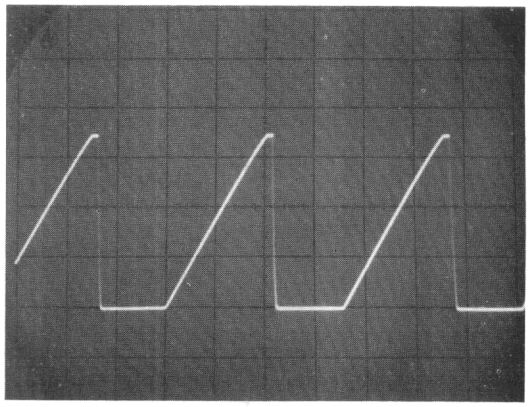


Figure 2-6. Component Identification Assembly A1

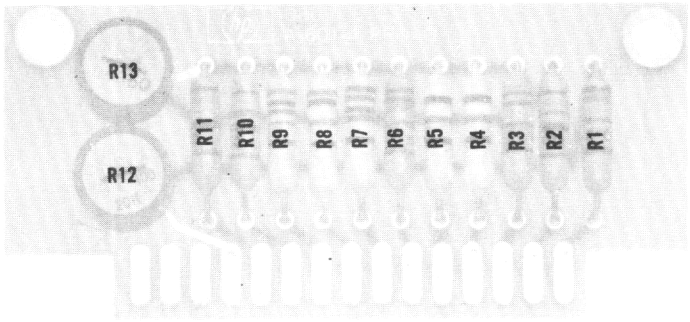


Junction A1R38, A1R39
20 V/div 5 ms/div

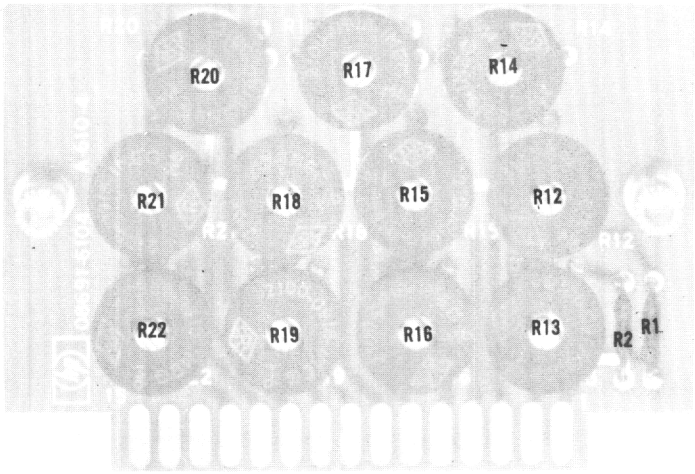


Emitter A1Q1
20 V/div 5 ms/div

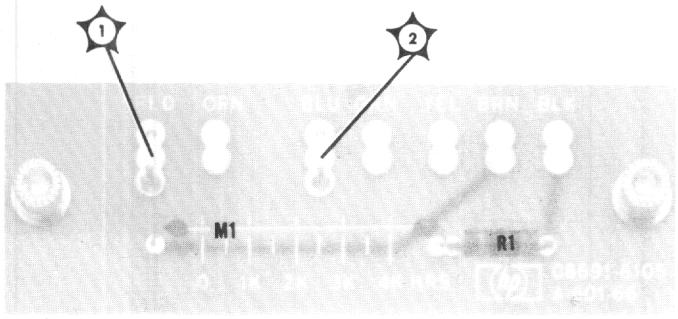
Figure 2-7. Waveforms



Assembly A2 (Standard Models)



Assembly A2 (Special Models)



Assembly A3

Figure 2-8. Component Identification, Assemblies A2, A3

SECTION III

REPLACEABLE PARTS

3-1. INTRODUCTION.

3-2. This section contains information for ordering replacement parts. Table 3-1 lists parts in alpha-numerical order of their reference designators and indicates the description and hp stock number of each part, together with any applicable notes. Miscellaneous parts are listed at the end of Table 3-1. Table 3-2 lists parts in alpha-numerical order of their hp stock number and provides the following information on each part:

a. Description.

b. Manufacturer of the part in a five-digit code; see list of manufacturers in Table 3-3.

c. Manufacturer's part number.

d. Total quantity used (TQ column).

3-3. ORDERING INFORMATION.

3-4. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office (see list at rear of this manual for addresses). Identify parts by their Hewlett-Packard Stock numbers.

3-5. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

3-6. BWO tubes listed as alternate replacement for particular BWO tubes are not strictly interchangeable. Alternate BWO tubes require different helix voltage shaping resistance values on Freq. Shape Assembly A2. For this reason, order a BWO replacement tube only by the hp stock number printed on the label of the BWO tube to be replaced.

REFERENCE DESIGNATORS

A = assembly	E = misc electronic part	P = plug	V = vacuum, tube, neon bulb, photocell, etc.
B = motor	F = fuse	Q = transistor	
BT = battery	FL = filter	R = resistor	VR = voltage regulator
C = capacitor	J = jack	RT = thermistor	W = cable
CP = coupler	K = relay	S = switch	X = socket
CR = diode	L = inductor	T = transformer	Y = crystal
DL = delay line	M = meter	TB = terminal board	
DS = device signaling (lamp)	MP = mechanical part	TP = test point	

ABBREVIATIONS

A = amperes	H = henries	NPN = negative-positive-negative	RMS = root-mean square
A.F.C. = automatic frequency control	HEX = hexagonal	NRFR = not recommended for field replacement	RWV = reverse working voltage
AMPL = amplifier	HG = mercury	NSR = not separately replaceable	
B.F.O. = beat frequency oscillator	HR = hour(s)		S-B = slow-blow
BE CU = beryllium copper	IF = intermediate freq		SCR = screw
BH = binder head	IMPG = impregnated		SE = selenium
BP = bandpass	INCD = incandescent		SECT = section(s)
BRS = brass	INCL = include(s)	OBD = order by description	SEMICON = semiconductor
BWO = backward wave oscillator	INS = insulation(ed)	OH = oval head	SI = silicon
	INT = internal	OX = oxide	SIL = silver
CCW = counter-clockwise	K = kilo = 1000		SL = slide
CER = ceramic			SPG = spring
CMO = cabinet mount only	LH = left hand	P = peak	SPL = special
COEF = coefficient	LIN = linear taper	PC = printed circuit	SST = stainless steel
COM = common	LK WASH = lock washer	PF = picofarads = 10 farads	SR = split ring
COMP = composition	LOG = logarithmic taper	PH BRZ = phosphor bronze	STL = steel
COMPL = complete	LPF = low pass filter	PHL = Phillips	TA = tantalum
CONN = connector	M = milli = 10^{-3}	PIV = peak inverse voltage	TD = time delay
CP = cadmium plate	MEG = meg = 10^{6}	PNP = positive-negative-positive	TGL = toggle
CRT = cathode-ray tube	MET FLM = metal film	P/O = part of	THD = thread
CW = clockwise	MET OX = metallic oxide	POLY = polystyrene	TI = titanium
DEPC = deposited carbon	MFR = manufacturer	PORC = porcelain	TOL = tolerance
DR = drive	MINAT = miniature	POS = position(s)	TRIM = trimmer
ELECT = electrolytic	MOM = momentary	POT = potentiometer	TWT = traveling wave tube
ENCAP = encapsulated	MTG = mounting	PP = peak-to-peak	U = micro = 10^{-6}
EXT = external	MY = "mylar"	PT = point	VAR = variable
F = farads	N = nano (10^{-9})	PWV = peak working voltage	VDCW = dc working volts
FH = flat head	N/C = normally closed	RECT = rectifier	W/ = with
FIL H = fillister head	NE = neon	RF = radio frequency	W = watts
FXD = fixed	NI PL = nickel plate	RH = round head or right hand	WIV = working inverse voltage
GE = germanium	N/O = normally open	RMO = rack mount only	WW = wirewound
GL = glass	NPO = negative positive zero (zero temperature coefficient)		W/O = without
GRD = ground(ed)			

Table 3-1. Reference Designation Index

Reference Designation	Stock No.	Description #	Note
A1	08691-6102	ASSY:"A" MODULATOR	
A1C1	0180-0161	C:FXD ELECT 3.3 UF 20% 35VDCW	
A1C2	0180-0116	C:FXD ELECT 6.8 UF 10% 35VDCW	
A1C3	0160-0383	C:FXD MICA 10 PF 10% 2500VDCW	
A1C4	0150-0052	C:FXD CER 0.05 UF 20% 400VDCW	
A1C5	0160-2216	C:FXD MICA 820 PF 5%	
A1C6	0140-0199	C:FXD MICA 240 PF 5% 300VDCW	
A1CR1	1901-0033	DIODE:SILICON 1N485B	
A1CR2	1901-0033	DIODE:SILICON 1N485B	
A1CR3 THRU A1CR11	1901-0096	DIODE:SILICON 120V 3 PF	
A1CR12THRU A1CR14	1901-0033	DIODE:SILICON 1N485B	
A1Q1	1854-0079	TRANSISTOR:SILICON 2N3439	
A1Q2	1853-0015	TRANSISTOR:SILICON PNP 2N3640	
A1Q3	1853-0037	TRANSISTOR:SILICON PNP	
A1Q4		NOT ASSIGNED	
A1Q5	1854-0003	TRANSISTOR:SILICON NPN	
A1Q6	1854-0079	TRANSISTOR:SILICON 2N3439	
A1Q7	1854-0003	TRANSISTOR:SILICON NPN	
A1Q8	1853-0010	TRANSISTOR:SILICON PNP	
A1R1	2100-1758	R:VAR WW 1K OHM 10% LIN 1/2W	
A1R2	0698-3428	R:FXD MET FLM 14.7 OHM 1% 1/8W	
A1R3	0757-0430	R:FXD MET FLM 2.21K OHM 1% 1/8W	
A1R4	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A1R5	0757-0442	R:FXD MET FLM 10K OHM 1% 1/8W	
A1R6	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A1R7	0757-0458	R:FXD MET FLM 51.1K OHM 1% 1/8W	
A1R8	0757-0428	R:FXD MET FLM 1.62K OHM 1% 1/8W	
A1R9	0757-0199	R:FXD MET FLM 21.5K OHM 1% 1/8W	
A1R10	0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	
A1R11	0698-3175	R:FXD MET FLM 147K OHM 1% 1/2W	
A1R12	0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	
A1R13	0757-0442	R:FXD MET FLM 10K OHM 1% 1/8W	
A1R14	2100-0969	R:VAR COMP 50K OHM 20% LIN 1/2W	
A1R15	0698-3151	R:FXD MET FLM 2.87K OHM 1% 1/8W	
A1R16	0757-0063	R:FXD MET FLM 196K OHM 1% 1/2W	
A1R17	0757-0839	R:FXD MET FLM 10K OHM 1% 1/2W	*
A1R18 THRU A1R22	0760-0023	R:FXD MET OX 150K OHM 1% 1W	
A1R23	0764-0007	R:FXD MET OX 27K OHM 5% 2W	
A1R24	2100-1775	R:VAR WW 5K OHM 10% LIN 1/2W	
A1R25 THRU A1R33	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A1R34	0761-0031	R:FXD MET OX 82K OHM 5% 1W	
A1R35	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A1R36	0698-3450	R:FXD MET FLM 42.2K OHM 1% 1/8W(8691A)	
A1R36	0698-3450	R:FXD MET FLM 42.2K OHM 1% 1/8W(8692A)	
A1R36	0698-3450	R:FXD MET FLM 42.2K OHM 1% 1/8W(8693A)	
A1R36	0757-0463	R:FXD MET FLM 82.5K OHM 1% 1/8W(8694A)	
A1R36	0757-0459	R:FXD MET FLM 56.2K OHM 1% 1/8W(H01-8694A)	
A1R36	0757-0462	R:FXD MET FLM 75.0K OHM 1% 1/8W(H02-8694A)	

See list of abbreviations in introduction to this section

Table 3-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A1R37	0757-0459	R:FXD MET FLM 56.2K OHM 1% 1/8W 8691A(1.0-2.0 GHZ)	*
A1R37	0757-0459	R:FXD MET FLM 56.2K OHM 1% 1/8W 8692A(2.0-4.0 GHZ)	*
A1R37	0757-0459	R:FXD MET FLM 56.2K OHM 1% 1/8W 8693A(4.0-8.0 GHZ)	*
A1R37	0698-3161	R:FXD MET FLM 38.3K OHM 1% 1/8W 8694A(8.0-12.4 GHZ)	*
A1R37	0698-3162	R:FXD MET FLM 46.4K OHM 1% 1/8W H01-8694A(7.0-12.4GHZ)	*
A1R37	0698-3161	R:FXD MET FLM 38.3K OHM 1% 1/8W H02-8694A(7.0-11.0 GHZ)	*
A1R38	0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	
A1R39	0757-0137	R:FXD MET FLM 750K OHM 2% 1/2W	
A1R40	2100-0945	R:VAR MET FLM 500K OHM 20% TYPE H	
A1R41	0757-0463	R:FXD MET FLM 82.5K OHM 1% 1/8W	
A1R42	2100-0945	R:VAR MET FLM 500K OHM 20% TYPE H	
A1R43	0757-0458	R:FXD MET FLM 51.1K OHM 1% 1/8W	
A1R44	0757-0867	R:FXD MET FLM 475K OHM 1% 1/2W	
A1V1	1940-0012	ELECTRON TUBE:8228	
A2	08691-6104	ASSY:FREQ SHAPE(8691A-8694A) SPECIAL MODELS	
A2R1	0757-0458	R:FXD MET FLM 51.1K OHM 1% 1/8W	
A2R2	0757-0458	R:FXD MET FLM 51.1K OHM 1% 1/8W	
A2R3 THRU A2R11		NOT ASSIGNED	
A2R12	2100-0917	R:VAR COMP 500K OHM 20% LIN 1/5W	*
A2R13	2100-0917	R:VAR COMP 500K OHM 20% LIN 1/5W	*
A2R14	2100-0918	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	*
A2R15	2100-0918	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	*
A2R16	2100-0918	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	*
A2R17	2100-0918	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	*
A2R18	2100-0918	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	*
A2R19	2100-0918	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	*
A2R20	2100-0918	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	*
A2R21	2100-0918	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	*
A2R22	2100-0918	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	*
A2	08691-6103	ASSY:FREQ SHAPE(8691A) USED W/1951-0020 BW0)	
A2R1 THRU A2R11		FACTORY SELECTED VALUE	*
A2R12	2100-1777	R:VAR COMP 20K OHM 10% LIN 1/2W	
A2R13	2100-0969	R:VAR COMP 50K OHM 20% LIN 1/2W	
A2	08692-6101	ASSY:FREQ SHAPE(8692A) USED W/1951-0064 BW0	
A2R1 THRU A2R13		FACTORY SELECTED VALUE	*
		* FACTORY SELECTED PART;TYPICAL VALUE GIVEN	

See list of abbreviations in introduction to this section

Table 3-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A2	08692-6102	ASSY:FREQ SHAPE(8692A) USED W/1951-0055 ALT BWO	
A2R1 THRU A2R13		FACTORY SELECTED VALUE	*
A2	08693-6101	ASSY:FREQ SHAPE(8693A) USED W/1951-0065 ALT BWO	
A2R1 THRU A2R13		FACTORY SELECTED VALUE	*
A2	08693-6102	ASSY:FREQ SHAPE(8693A) USED W/1951-0057 BWO	
A2R1 THRU A2R13		FACTORY SELECTED VALUE	*
A2	08694-6101	ASSY:FREQ SHAPE(8694A) USED W/1951-0066 ALT BWO	
A2R1 THRU A2R13		FACTORY SELECTED VALUE	*
A2	08694-6102	ASSY:FREQ SHAPE(8694A) USED W/1951-0058 BWO	
A2R1 THRU A2R13		FACTORY SELECTED VALUE	*
A2	08694-6103	ASSY:FREQ SHAPE(H01-8694A) USED W/1951-0066 ALT BWO	
A2R1 THRU A2R13		FACTORY SELECTED VALUE	*
A2	08694-6104	ASSY:FREQ SHAPE(H01-8694A) USED W/1951-0058 BWO	
A2R1 THRU A2R13		FACTORY SELECTED VALUE	*
A2	08694-6105	ASSY:FREQ SHAPE(H02-8694A) USED W/1951-0066 ALT BWO	
A2R1 THRU A2R13		FACTORY SELECTED VALUE	*
A2	08694-6106	ASSY:FREQ SHAPE(H02-8694A) USED W/1951-0058 BWO	
A2R1 THRU A2R13		FACTORY SELECTED VALUE	*
A3	08691-6105	BOARD ASSY:BWO TERM	
A3M1	1010-0005	INDICATOR:ELAPSED TIME	
A3R1	0686-2455	R:FXD COMP 2.4 MEGOHM 5% 1/2W	
		* FACTORY SELECTED PART;TYPICAL VALUE GIVEN	

See list of abbreviations in introduction to this section

Table 3-1. Reference Designation Index (Cont' d)

Reference Designation	℗ Stock No.	Description #	Note
A4	08691-6110	DETECTOR:DIRECTIONAL(8691A, OPT 01)	
A4	08692-6110	DETECTOR:DIRECTIONAL(8692A, OPT 01)	
A4	08693-6110	DETECTOR:DIRECTIONAL(8693A, OPT 01)	
A5	1130-0032	COUPLER:DIRECTIONAL(8694A, OPT 01, H01-8694A, OPT 01, H02-8694A, OPT 01)	
A6	08694-6110	DETECTOR:CRYSTAL(8694A, OPT 01, H01-8694A, OPT 01, H02-8694A, OPT 01)	
CP1	1250-0777	ADAPTER:UG29(8694A, OPT 01, H01-8694A OPT 01, H02-8694A, OPT 01)	
DS1	2140-0092	LAMP:INCANDESCENT 60 MA 5V	
	1450-0152	LENS:RED PLASTIC	
	1450-0153	LAMPHOLDER:FOR T-1 SERIES	
FL1	3600	FILTER:LOW PASS(8692A OPT 01)	
	00694-604	FILTER:LOW PASS(8694A OPT 01, H01-8694A OPT 01, H02-8694A OPT 01)	
J1	1250-0083	CONNECTOR:RF BNC	
R1	2100-2009	R:VAR COMP 2 SECT 1K OHM 20% LIN	
R2		PART OF R1	
R3	2100-0060	R:VAR COMP 20K OHM 20% LIN 2.25W	
R4		FACTORY SELECTED VALUE	*
S1	3101-0957	SWITCH:DPDT(OPT 01)	
V1	1951-0020	ELECTRON TUBE:BWO(8691A)	
V1	1951-0064	ELECTRON TUBE:BWO(8692A)	
V1	1951-0057	ELECTRON TUBE:BWO(8693A)	
V1	1951-0058	ELECTRON TUBE:BWO(8694A,H01-8694A,H02-8694A)	
V1	1951-0066	ELECTRON TUBE:BWO(ALT FOR 1951-0058)	1
V1	1951-0065	ELECTRON TUBE:BWO(ALT FOR 1951-0057)	1
V1	1951-0055	ELECTRON TUBE:BWO(ALT FOR 1951-0064)	1
W1	08691-6003	CABLE ASSY:8691A OPT 01	
W1	08691-6003	CABLE ASSY:8692A OPT 01	
W1	08691-6003	CABLE ASSY:8693A OPT 01	
W1	08691-6003	CABLE ASSY:8694A OPT 01,H01-8694A OPT 01, H02-8694A OPT 01.	
		MISCELLANEOUS	
	0370-0133	KNOB:5/8" DIA 1/4" SHAFT	
	3150-0054	FILTER:AIR	
	08691-0100	PANEL:FRONT(8691A)	
	08691-2003	HANDLE ASSY	
	08691-2110	SCALE:1.0-2.0 GHZ(8691A)	
		* FACTORY SELECTED PART;TYPICAL VALUE GIVEN	
		1=REFER TO PARAGRAPH 3-6.	

See list of abbreviations in introduction to this section

Table 3-1. Reference Designation Index (Cont'd)

Reference Designation	℗ Stock No.	Description #	Note
	08691-2112	PANEL:REAR	
	08692-0100	PANEL:FRONT(8692A)	
	08692-2110	SCALE:2.0-4.0 GHZ(8692A)	
	08693-0100	PANEL:FRONT(8693A)	
	08693-2110	SCALE:4.0-8.0 GHZ(8693A)	
	08694-0100	PANEL:FRONT(8694A & OPT 01)	
	08694-0102	PANEL:FRONT(H01-8694A & OPT 01)	
	08694-0104	PANEL:FRONT(H02-8694A & OPT 01)	
	08694-2110	SCALE:8.0-12.4 GHZ(8694A & OPT 01)	
	08694-2111	SCALE:7.0-12.4 GHZ(H01-8694A & OPT 01)	
	08694-2112	SCALE:7.0-11.0 GHZ(H02-8694A & OPT 01)	

See list of abbreviations in introduction to this section

Table 3-2. Replaceable Parts

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
0140-0199	C:FXD MICA 240 PF 5% 300VDCW	04062	DM15F241J	1
0150-0052	C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A	1
0160-0383	C:FXD MICA 10 PF 10% 2500VDCW	28480	0160-0383	1
0160-2216	C:FXD MICA 820 PF 5%	28480	0160-2216	1
0180-0116	C:FXD ELECT 6.8 UF 10% 35VDCW	56289	150D685X903582	1
0180-0161	C:FXD ELECT 3.3 UF 20% 35VDCW	56289	150D335X003582	1
3600	FILTER:LOW PASS(8692A OPT 01)	28480	3600	1
0370-0133	KNOB:5/8" DIA 1/4" SHAFT	28480	0370-0133	1
00694-604	FILTER:LOW PASS(8694A,H01,H02, OPT 01)	28480	00694-604	1
0686-2455	R:FXD COMP 2.4 MEGOHM 5% 1/2W	01121	EB 2455	1
0698-3151	R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151	1
0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157	1
0698-3161	R:FXD MET FLM 38.3K OHM 1% 1/8W	28480	0698-3161	2
0698-3162	R:FXD MET FLM 46.4K OHM 1% 1/8W	28480	0698-3162	1
0698-3175	R:FXD MET FLM 147K OHM 1% 1/2W	28480	0698-3175	1
0698-3428	R:FXD MET FLM 14.7 OHM 1% 1/8W	28480	0698-3428	1
0698-3450	R:FXD MET FLM 42.2K OHM 1% 1/8W	28480	0698-3450	3
0757-0063	R:FXD MET FLM 196K OHM 1% 1/2W	28480	0757-0063	1
0757-0137	R:FXD MET FLM 750K OHM 2% 1/2W	28480	0757-0137	1
0757-0199	R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199	1
0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280	10
0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401	1
0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416	2
0757-0428	R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428	1
0757-0430	R:FXD MET FLM 2.21K OHM 1% 1/8W	28480	0757-0430	1
0757-0442	R:FXD MET FLM 10K OHM 1% 1/8W	28480	0757-0442	2
0757-0458	R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458	4
0757-0459	R:FXD MET FLM 56.2K OHM 1% 1/8W	28480	0757-0459	4
0757-0462	R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462	1
0757-0463	R:FXD MET FLM 82.5K OHM 1% 1/8W	28480	0757-0463	2
0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465	1
0757-0839	R:FXD MET FLM 10K OHM 1% 1/2W	28480	0757-0839	1
0757-0867	R:FXD MET FLM 475K OHM 1% 1/2W	28480	0757-0867	1
0760-0023	R:FXD MET OX 150K OHM 1% 1W	28480	0760-0023	5
0761-0031	R:FXD MET OX 82K OHM 5% 1W	28480	0761-0031	1
0764-0007	R:FXD MET OX 27K OHM 5% 2W	07115	C 42S	2
1010-0005	INDICATOR:ELAPSED TIME	28480	1010-0005	1
1130-0032	COUPLER:DIRECTIONAL	28480	1130-0032	1
1250-0083	CONNECTOR:RF BNC	28480	1250-0083	1
1250-0777	ADAPTER:UG29	28480	1250-0777	1
1450-0152	LENS:RED PLASTIC	08717	102XX-R	1
1450-0153	LAMPHOLDER:FOR T-1 SERIES	08717	102SR	1
1853-0010	TRANSISTOR:SILICON PNP	28480	1853-0010	1
1853-0015	TRANSISTOR:SILICON PNP 2N3640	07263	2N3640	1
1853-0037	TRANSISTOR:SILICON PNP	28480	1853-0037	1
1854-0003	TRANSISTOR:SILICON NPN	28480	1854-0003	2
1854-0079	TRANSISTOR:SILICON 2N3439	02735	2N3439	2
1901-0033	DIODE:SILICON 1N485B	28480	1901-0033	5
1901-0096	DIODE:SILICON 120V 3 PF	28480	1901-0096	9
1940-0012	ELECTRON TUBE:8228	73445	8228/ZZ1000	1
1951-0020	ELECTRON TUBE:BWO(8691A)	28480	1951-0020	1

See list of abbreviations in introduction to this section

Table 3-2. Replaceable Parts (Cont'd)

℗ Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
1951-0055	ELECTRON TUBE:BWO	28480	1951-0055	1
1951-0057	ELECTRON TUBE:BWO(8693A)	28480	1951-0057	1
1951-0058	ELECTRON TUBE:BWO(8694A)	28480	1951-0058	1
1951-0064	ELECTRON TUBE:BWO(8692A)	28480	1951-0064	1
1951-0065	ELECTRON TUBE:BWO	28480	1951-0065	1
1951-0066	ELECTRON TUBE:BWO	28480	1951-0066	1
2100-0060	R:VAR COMP 20K OHM 20% LIN 2.25W	28480	2100-0060	1
2100-0917	R:VAR COMP 500K OHM 20% LIN 1/5W	28480	2100-0917	2
2100-0918	R:VAR COMP 1 MEGOHM 20% LIN 1/5W	28480	2100-0918	9
2100-0945	R:VAR MET FLM 500K OHM 20% TYPE H	28480	2100-0945	2
2100-0969	R:VAR COMP 50K OHM 20% LIN 1/2W	28480	2100-0969	2
2100-1758	R:VAR WW 1K OHM 10% LIN 1/2W	28480	2100-1758	1
2100-1775	R:VAR WW 5K OHM 10% LIN 1/2W	28480	2100-1775	1
2100-1777	R:VAR COMP 20K OHM 10% LIN 1/2W	28480	2100-1777	1
2100-2009	R:VAR COMP 1K OHM 20% LIN(2 SECT)	28480	2100-2009	1
2140-0092	LAMP:INCANDESCENT 60 MA 5V	71744	CM8-685	1
3101-0957	SWITCH:DPDT	88140	8909K310	1
3150-0054	FILTER:AIR	28480	3150-0054	1
08691-0100	PANEL:FRONT(8691A)	28480	08691-0100	1
08691-2003	HANDLE ASSY	28480	08691-2003	1
08691-2110	SCALE:1.0-2.0 GHZ(8691A)	28480	08691-2110	1
08691-2112	PANEL:REAR	28480	08691-2112	1
08691-6003	CABLE ASSY(8691A,8692A,8693A,8694A)	28480	08691-6003	4
08691-6102	ASSY:"A" MODULATOR	28480	08691-6102	1
08691-6103	ASSY:FREQ SHAPE(8691A)	28480	08691-6103	1
08691-6104	ASSY:FREQ SHAPE(8691A)	28480	08691-6104	1
08691-6105	BOARD ASSY:BWO TERM	28480	08691-6105	1
08691-6110	DETECTOR:DIRECTIONAL(8691A OPT 01)	28480	08691-6110	1
08692-0100	PANEL:FRONT(8692A)	28480	08692-0100	1
08692-2110	SCALE:2.0-4.0 GHZ(8692A)	28480	08692-2110	1
08692-6101	ASSY:FREQ SHAPE(8692A)	28480	08692-6101	1
08692-6102	ASSY:FREQ SHAPE(8692A)	28480	08692-6102	1
08692-6110	DETECTOR:DIRECTIONAL(8692A OPT 01)	28480	08692-6110	1
08693-0100	PANEL:FRONT(8693A)	28480	08693-0100	1
08693-2110	SCALE:4.0-8.0 GHZ(8693A)	28480	08693-2110	1
08693-6101	ASSY:FREQ SHAPE(8693A)	28480	08693-6101	1
08693-6102	ASSY:FREQ SHAPE(8693A)	28480	08693-6102	1
08693-6110	DETECTOR:DIRECTIONAL(8693A OPT 01)	28480	08693-6110	1
08694-0100	PANEL:FRONT(8694A & OPT 01)	28480	08694-0100	1
08694-0102	PANEL:FRONT(H01-8694A & OPT 01)	28480	08694-0102	1
08694-0104	PANEL:FRONT(H02-8694A & OPT 01)	28480	08694-0104	1
08694-2110	SCALE:8.0-12.4 GHZ(8694A & OPT 01)	28480	08694-2110	1
08694-2111	SCALE:7.0-12.4 GHZ(H01-8694A & OPT 01)	28480	08694-2111	1
08694-2112	SCALE:7.0-11.0 GHZ(H02-8694A & OPT 01)	28480	08694-2112	1
08694-6101	ASSY:FREQ SHAPE(8694A)	28480	08694-6101	1
08694-6102	ASSY:FREQ SHAPE(8694A)	28480	08694-6102	1
08694-6103	ASSY:FREQ SHAPE(H01-8694A)	28480	08694-6103	1
08694-6104	ASSY:FREQ SHAPE(H01-8694A)	28480	08694-6104	1
08694-6105	ASSY:FREQ SHAPE(H02-8694A)	28480	08694-6105	1
08694-6106	ASSY:FREQ SHAPE(H02-8694A)	28480	08694-6106	1
08694-6110	DETECTOR:CRYSTAL(8694A,H01,H02, OPT 01)	28480	08694-6110	1

See list of abbreviations in introduction to this section

TABLE 3-3.
CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Cemco Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Microtron Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc., Electronics Products Div.	Camden, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp. Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
00929	Micriolab Inc.	Livingston, N.J.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant	Sumerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N.J.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Chicago, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P.M. Motor Company	Westchester, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illumitronic Engineering Co.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., The	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amalom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Semcor Div. Components Inc.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.	San Carlos, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07261	Avnet Corp.	Culver City, Calif.
07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp., The	Monterey Park, Calif.
07700	Technical Wire Products Inc.	Cranford, N.J.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.
07966	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08289	Blinn, Delbert Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08792	CBS Electronics Semiconductor Operations, Div of C.B.S. Inc.	Lowell, Mass.
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Atohm Electronics	Sun Valley, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Calif.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12136	Philadelphia Handle Co.	Camden, N.J.
12697	Clarostat Mfg. Co.	Dover, N.H.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13103	Thermolloy	Dallas, Texas
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dublier Electric Corp.	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	So. Pasadena, Calif.
14960	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Electronics Co.	New York, N.Y.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15558	Micron Electronics	Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.	Lynbrook, N.Y.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15818	Ametco Inc.	Mt. View, Calif.
15909	Daven Div. Thomas A. Edison Ind. McGraw-Edison Co.	Long Island City, N.Y.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Detroit, Ill.
16352	Computer Diode Corp.	Lodi, N.J.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Inc.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Calif.
18042	Power Design Pacific Inc.	Palo Alto, Calif.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	Bendix Corp., The Eclipse-Poineer Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
37942	P.R. Mallory & Co. Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.

00015-42
Revised: July, 1966

From: FSC. Handbook Supplements
H4-1 Dated JULY 1965
H4-2 Dated NOV 1962

TABLE 3-3.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Company	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex, Inc.	St. Paul, Minn.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Revere Wollansak Div. Minn. Mining & Mfg. Co.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema Plant, Hi-Q Div. Aerovox Corp.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71753	A.O. Smith Corp., Crowley Div.	West Orange, N.J.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72354	John E. Fast Co., Div. Victoreen Instr. Co.	Chicago, Ill.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap. Div.	Newark, N.J.
72765	Drake Mfg. Co.	Chicago, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. of North American Phillips Co., Inc.	Hicksville, N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75378	CTS Knights Inc.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlelуse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	Bendix Corp., The Bendix Pacific Div.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80130	Times Telephoto Equipment	New York, N.Y.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards	Washington, DC.
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Adhesive Label Corp.	Monrovia, Calif.
80583	Hammarlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	. . . . .
81483	International Rectifier Corp.	El Segundo, Calif.
81541	Airpax Electronics, Inc.	Cambridge, Mass.
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp., Defense Prod. Division	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfg. Co.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.
83186	Victory Engineering Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	TRW Capacitor Div.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.

From: FSC. Handbook Supplements
H4-1 Dated JULY 1965
H4-2 Dated NOV. 1962

00015-42
Revised: July, 1966

TABLE 3-3.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N.J.
87034	Marco Industries	Anaheim, Calif.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88421	Federal Telephone & Radio Corp.	Clifton, N.J.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Calif.
89665	United Transformer Co.	Chicago, Ill.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co. Inc.	Rochester, N.Y.
92196	Universal Industries, Inc.	City of Industry, Calif.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins and Myers, Inc.	New York, N.Y.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Tung-Sol Electric, Inc.	Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94310	Tru-Ohm Products Memcor Components Div.	Huntington, Ind.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95264	Lerco Electronics, Inc.	Burbank, Calif.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Chicago, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Troncis, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Calif.
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.	Palo Alto, Calif.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind. Elect. Products Div.	San Marino, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

0000F	Malco Tool and Die	Los Angeles, Calif.
0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AA	British Radio Electronics Ltd.	Washington, D.C.
000AB	ETA	England
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Mfg. Co.	San Jose, Calif.
000QQ	Cooltron	Oakland, Calif.
000WW	California Eastern Lab.	Burlington, Calif.
000YY	S.K. Smith Co.	Los Angeles, Calif.

From: FSC. Handbook Supplements
H4-1 Dated JULY 1965
H4-2 Dated NOV. 1962

00015-42
Revised: July, 1966

SECTION IV
SCHEMATIC DIAGRAMS

4-1. INTRODUCTION.

4-2. Schematic presentations in this manual show electrical circuit operation and are not intended to serve as wiring diagrams. Figure 4-1 lists notes which apply to the schematic diagrams.

4-3. Some switch and circuit board assemblies are shown in part on different pages. To find a specific instrument component, refer to the "REFERENCE DESIGNATIONS" box which appears on each schematic diagram. Reference designations within assemblies are abbreviated. The full designation includes the assembly on which the component is mounted, and the individual component designation. For example, Resistor R1 mounted on Assembly A1 has the complete reference designation of A1R1. Certain parts are not included on assemblies, and are classified as chassis parts. Chassis parts are assigned only the reference designation shown on the schematic diagram.

4-4. An asterisk indicates a factory selected part; the component value shown is the typical or most commonly selected value.

4-5. Component procurement information and specific component descriptions are included in Section III. Refer to page 3-1 for information on how to order parts.

1. Resistance in ohms, capacitance in microfarads unless otherwise indicated

2. Screwdriver adjustment

   Panel control

3. Front panel designation

   Rear panel designation

4. Etched circuit borderline

   Signal path

   Feedback path

5. P/O = Part Of

6. CW — Wiper moves toward CW with clockwise rotation of control.

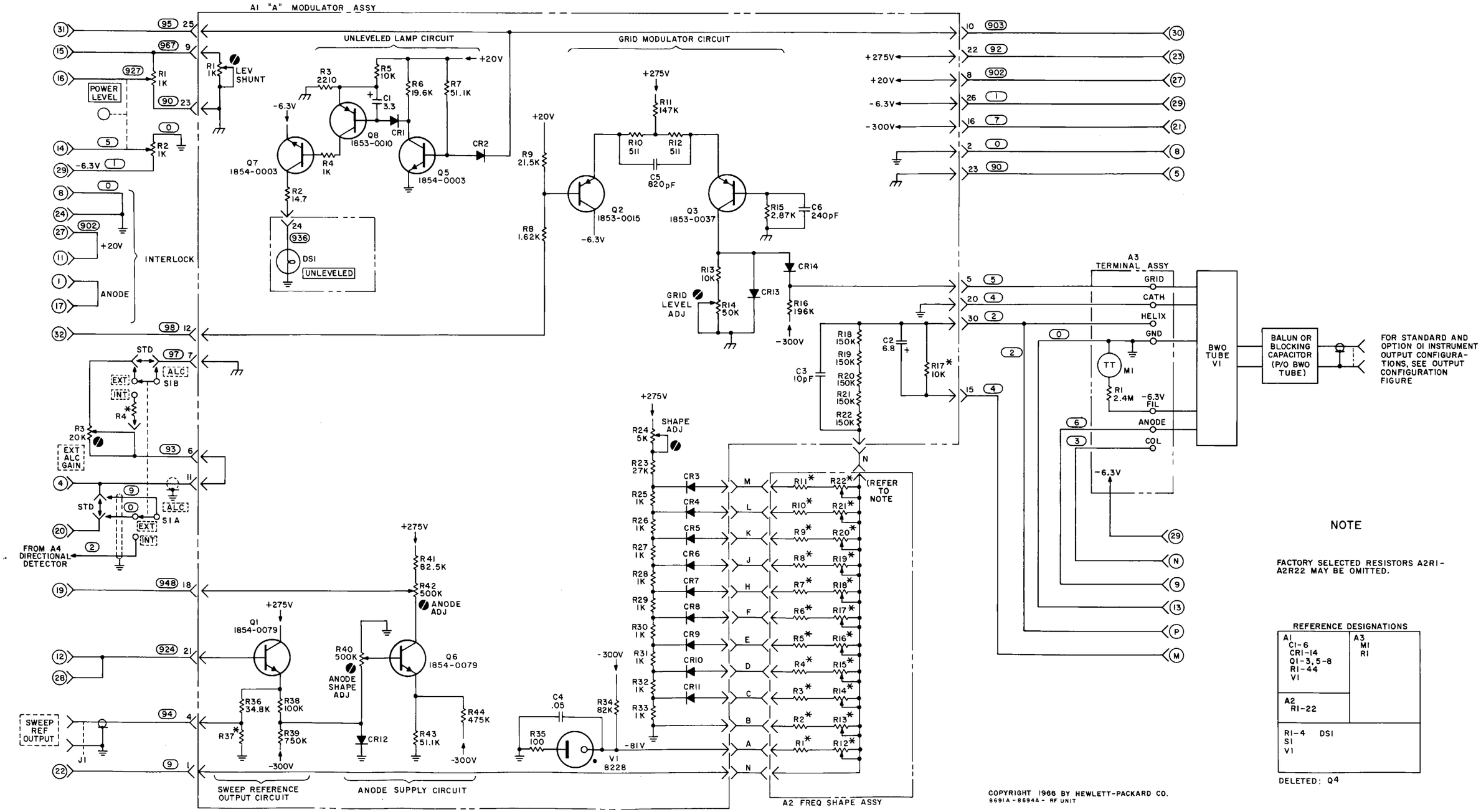
7. 18 — Test point. Number in circle matches TP number on circuit board illustration.

8. Voltage regulator (breakdown) diode.

9. Encloses wire color code. Wire color code same as resistor code. First number identifies ground color, second number identifies wider stripe, third number identifies narrower stripe. E.g., (947) denotes white ground, yellow wide stripe, violet narrow stripe.

10. *Denotes a factory-selected value. Typical value shown. Part may be omitted.

Figure 4-1. Schematic Diagram Notes



NOTE

FACTORY SELECTED RESISTORS A2R1-A2R22 MAY BE OMITTED.

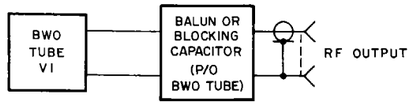
REFERENCE DESIGNATIONS

A1 C1-6 CR1-14 Q1-3, 5-8 R1-44 V1	A3 M1 R1
A2 R1-22	
R1-4 DS1 S1 V1	

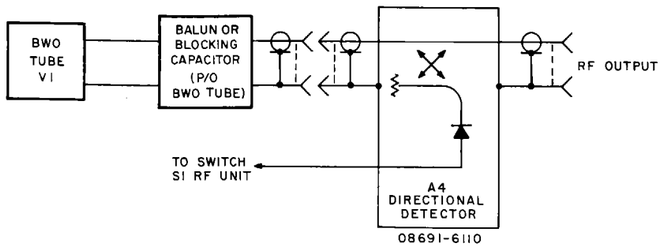
DELETED: Q4

Figure 4-2. RF Unit

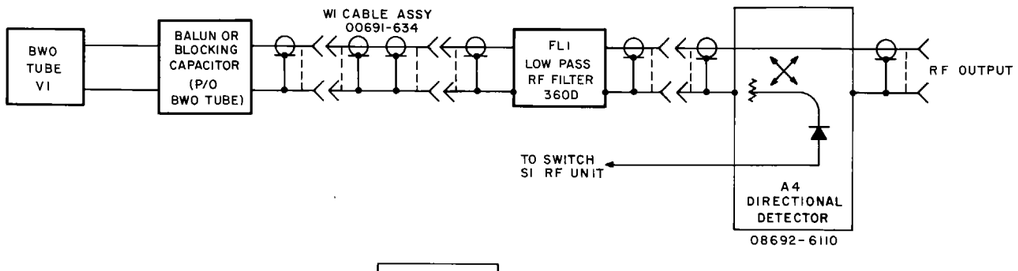
STANDARD MODELS: 8691A, 8692A, 8693A, 8694A



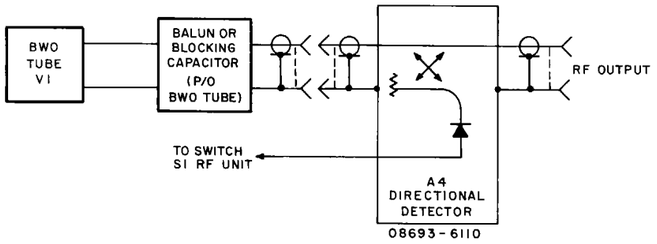
OPTION 01 MODEL: 8691A



OPTION 01 MODEL: 8692A



OPTION 01 MODEL: 8693A



OPTION 01 MODEL: 8694A

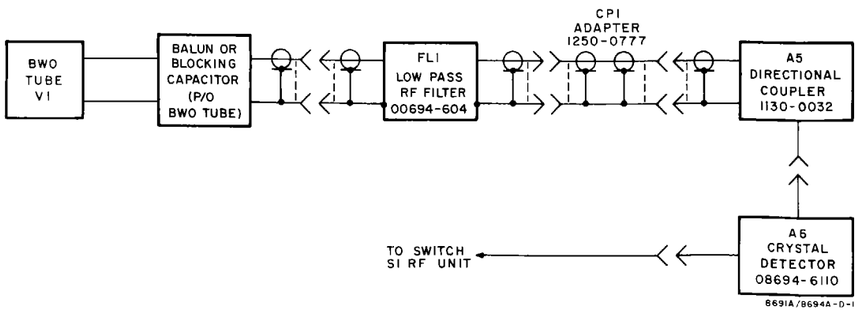


Figure 4-3. Output Configurations

APPENDIX I

DIRECTIONAL DETECTORS

models
786D
787D
788C

OPERATING NOTE 3 AUG 66

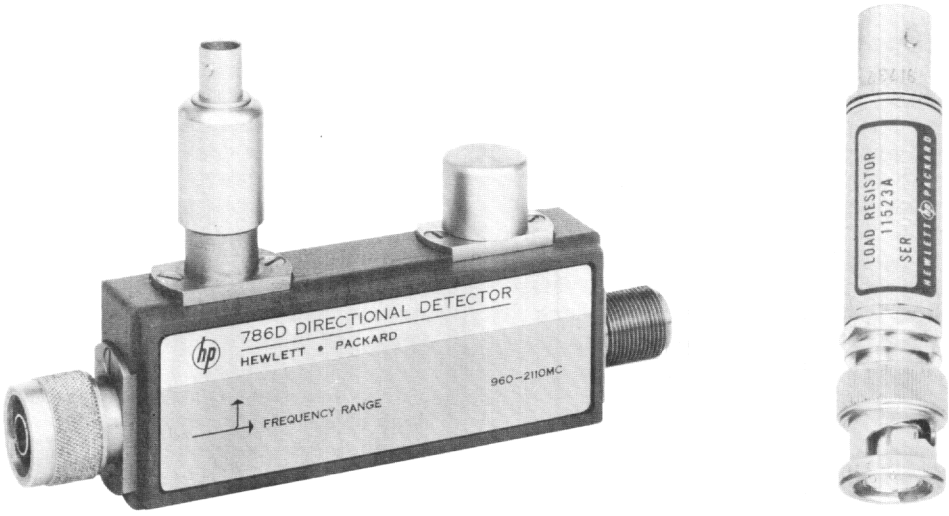


Figure 1. Model 786D and Option 02 Accessory Load Resistor

Table 1. Specifications

Model	Frequency Range (Gc)	Sensitivity[1]		Minimum Directivity	Equivalent Source Reflection Coefficient[6]	Frequency Response[3]	Max Main Line SWR	Max Main Line Input	Insertion Loss[4]
		Low Level	High Level[2]						
786D	0.96 - 2.11	>4 μv/μw CW	35 mw	30 db	≤ 0.06 (1.13 swr)	±0.2 db	1.15	10 w	≈0.25 db
787D	1.9 - 4.1	>4 μv/μw CW	35 mw	26 db	≤ 0.075 (1.16 swr)	±0.2 db	1.15	10 w	≈0.35 db
788C	3.7 - 8.3	>40 μv/μw CW	3.5 mw	20 db	≤ 0.111 (1.25 swr)	±0.3 db	1.20	1 w	≈0.6 db

Noise: Less than 200 μv peak-to-peak with CW power applied to produce 100 mv output

Detector Output Polarity: Negative

Detector Output Connector: BNC female

Detector Output Impedance: 15K max shunted by about 10 pf

Detector Element: Supplied

RF Connectors[5]: hp precision type N, one male (input), one female

Size: Refer to Figure 2

Net Weight:
786D - 16 oz (450 g)
787D - 12 oz (340 g)
788C - 12 oz (340 g)

Options:
02. Furnished hp 11523A load resistor for optimum square-law characteristics at 24°C (75°F), <±0.5 db variation from square-law for outputs up to 50 mv peak (working into an external load >75K). Sensitivity when load is used is typically >1 μv/μw CW for 786D and 787D, and >10 μv/μw CW for 788C.
03. Positive polarity detector output.

[1] With respect to power output

[2] Power required to produce at least a 100-mv output

[3] As read on a meter calibrated for square law

[4] Including loss due to coupling

[5] CAUTION: hp precision type N connectors do not mate with each other. They mate only with standard type N connectors.

[6] The apparent reflection coefficient at the output of an RF generating system, such as the output of a directional detector when it is used in a closed-loop leveling system.

01986-4

Printed in U.S.A.

1. INTRODUCTION.

2. The Directional Detector, a directional coupler with built-in crystal detector, is designed for use in coaxial systems over a relatively wide frequency range. Applications include closed-loop leveling, observation of RF envelope variation, and power monitoring. Output polarity of detected signal is normally negative, but positive output polarity is available as Option 03. Figure 1 shows Model 786D with Option 02 Load Resistor, available when optimum conformance to square-law characteristics is required. Table 1 lists complete instrument specifications.

3. The directional detector and the optional square-law load (hp 11523A) are separately housed. This arrangement permits choice of directional detector operation for optimum square-law response for detected outputs of up to 50 mv (with the load attached) or maximum output sensitivity (without the load). For proper identification the directional detector carries the same serial number as the load. Always check that the serial number of the load and directional detector are identical.

4. PRECAUTIONS.

5. STATIC ELECTRICAL DAMAGE.

6. The maximum pulse rating for the detector element (diode) used in the directional detector is 0.1 erg of energy. A four-foot length of coaxial RG58/U cable, the equivalent of a 100-pf capacitor, when charged to 14 volts, is the equivalent of 0.1 erg of energy. Be certain that connecting cables are always connected to associated equipment and discharged before connecting to the detector output.

7. HANDLING DAMAGE.

8. DO NOT HANDLE DETECTOR ELEMENT NEEDLESSLY. Static electricity which builds up on the body, especially on cold, dry days, must never be allowed to discharge through the detector element. Avoid exposed leads to or from the detector output, since these are often touched accidentally. Refer to Paragraph 23 for proper precautions.

9. OPERATION.

10. The directional detector is useful as the sampling and detection device in closed-loop leveling setups as described in Paragraph 16. It can also be used as a calibrated power monitor by determining the correlation between detected output and main-line RF output levels, or for relative RF envelope observation with an oscilloscope. If the directional detector is to be permanently mounted for any application, refer to Figure 2, which illustrates the location of the four mounting holes and the general side dimensions. Before installing in any setup, the following should be considered:

a. The type N connectors are hp precision type N connectors which are designed to mate with standard 50-ohm type N connectors. When mating with any other device equipped with hp precision type N connectors, connector damage will result unless an adapter is used. Precision connector dimensions are given in Figure 3.

b. The detector element used is sensitive to either amplitude-modulated or continuous-wave (CW) RF power. If RF power is amplitude modulated at a 1000-cps ±2% rate, the sensitive hp Model 415B or 415D (SWR Meter) can be used as the indicator. For CW detection, a DC milliammeter or millivoltmeter (with an input impedance of at least 100K ohms), such as the hp Model 425A Microvolt-Ammeter can be used as the indicator.

c. When using an oscilloscope to observe waveshapes of rise times less than 5 μsec, the coaxial cable connecting the detected output and the oscilloscope should be as short as possible and terminated with a shunting resistor. Ideally, this resistor should be 50 ohms to terminate the coaxial cable in its characteristic impedance. However, with 50 ohms, the video pulse may have too small an amplitude to drive some oscilloscopes. Typically, the required value is between 50 and 2000 ohms. The larger the resistance, the slower the observable rise time. Oscilloscopes ideal for this application are the hp Models 140A or 175A, depending upon required bandwidth.

d. A low-pass filter should be used in all applications of the directional detector where harmonic frequencies may be present.

11. SENSITIVITY CHARACTERISTICS.

12. The sensitivity characteristics of the Directional Detectors is well defined in two ranges of main line RF power output, a lower range extending up to 500 μw (50 μw for the 788C) and a higher range between 5 and 35 mw (0.5 and 3.5 mw for the 788C). In the lower range the ratio of detected output to main line RF power output (sensitivity), in microvolts per microwatt, is at least 4:1 (40:1 for the 788C). In the higher range the ratio, in millivolts per milliwatt, is at least 2.85:1 (28.5:1 for the 788C). Between ranges, and beyond the higher range, sensitivity characteristics vary from detector element to detector element. Beyond the higher range sensitivity diminishes to a saturation level (a maximum detected output of 300 to 500 mv) where increased main line RF power produces no significant increase in detected output.

13. SQUARE-LAW LOADING.

14. The square-law load (hp 11523A) is selected for optimum response (minimum deviation from square law) at 24°C (75°F). Typically, detected output varies ±0.3 db from exact square law for values of output voltage between 5 mv and 50 mv. At higher temperatures output voltage vs input power deviation is more negative and at lower temperatures the opposite is true. The change with temperature is approximately 0.04 db/°C. For example, a detected output which varies ±0.3 db from exact square law at 24°C would vary about -0.2 to +0.4 db at 22°C (72°F).

15. CLOSED-LOOP LEVELING.

16. TECHNIQUE. The Directional Detector has a direct application in systems employing closed-loop leveling of an RF source. Any variation in the RF output level causes a proportional variation in the detected output level, and this is fed back to maintain a virtually constant RF output level. Generally, an

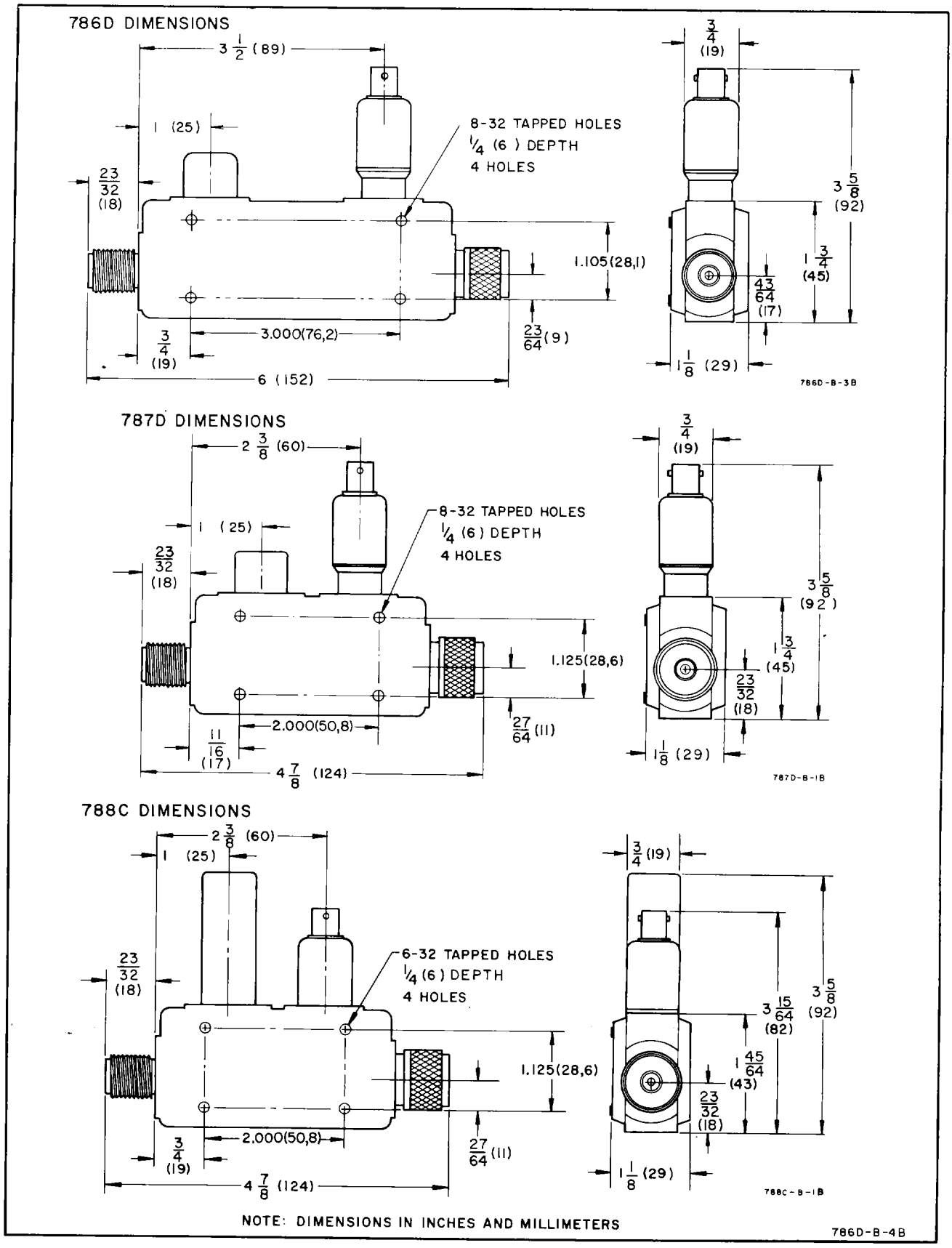


Figure 2. Outside Dimensions

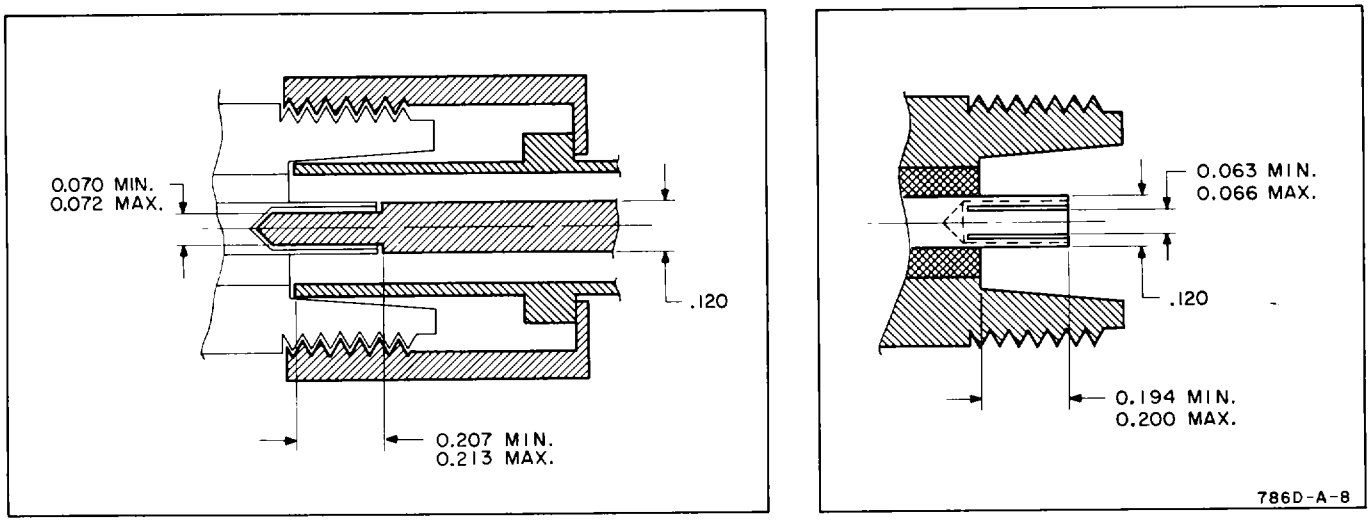
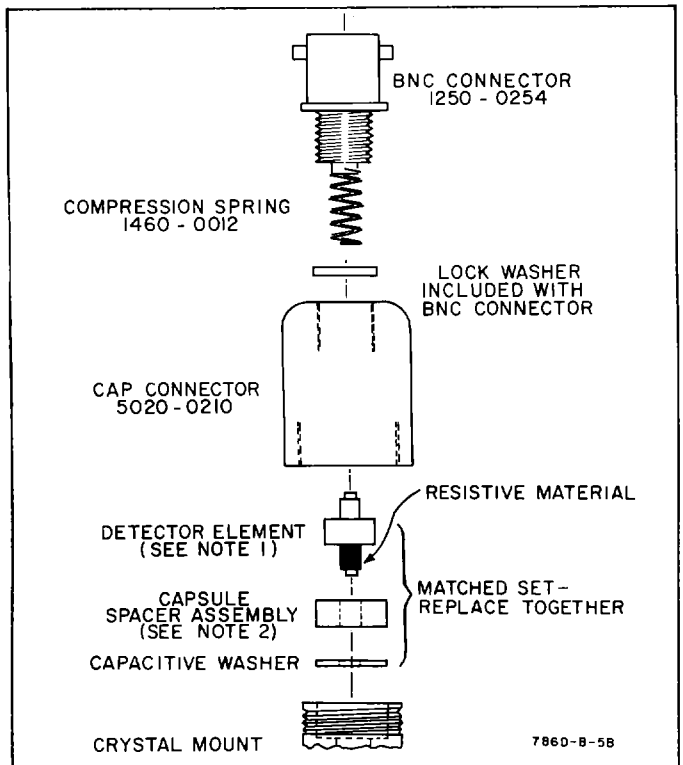


Figure 3. Precision Type N Connector Dimensions

amplifier, such as the Ⓗ Model H01-8401A is required between the detector and the RF source, although some sources such as the Ⓗ 690 series Sweep Oscillators have built-in leveling amplifiers.



NOTES

1. Negative polarity diode #00423-802 (00423-800 if matched load resistor needed for 11523A); positive polarity diode #00423-803 (00423-801 if matched load resistor needed for 11523A).
2. Capsule spacer includes polyiron insert. Capsule spacer must always be inserted so that black polyiron insert contacts with crystal mount (not under side of diode). Use with new washer furnished.

786D-8-5

Figure 4. Detector Unit Assembly

17. LEVELING CAPABILITY. The leveling capability of the leveler-amplifier/directional-detector combination is limited mainly by the frequency response of the detector and the response of the leveler amplifier. When the 786D is used to level the Ⓗ Model 691A Sweep Oscillator, RF variations into a matched load are less than ±0.3 db.

18. CALIBRATED POWER MONITOR.

19. The Directional Detector can also be used as a power monitor. By determining the correlation between the detected output and the main-line RF output levels the detected output can be calibrated directly in mv/mw and the directional detector can then be used to sample and indicate RF power levels at any point in a system. A power meter can be used to measure main-line RF output levels for calibration of the detected output. An Oscilloscope, DC Voltmeter, or SWR Meter can be used to measure the detected output.

20. MAINTENANCE.

21. Succeeding paragraphs give instructions for repair of the directional detector and the 11523A (Option 02) Load Resistor. Figure 4 illustrates the replaceable detector assembly for the 786D, 787D, and 788C. Figure 5 illustrates the replaceable load assembly for the 788C, 786D and 787D load assemblies are not field-replaceable. Figure 6 and 7 illustrate the replaceable 11523A load resistor assembly. Stock numbers required when ordering replacement parts are given in the respective assembly illustrations. To order a replacement part, address order of inquiry to your local Hewlett-Packard sales and service office (see listings at the rear of this Note).

22. DETECTOR ELEMENT REPLACEMENT.

CAUTION

The detector element (see Figure 4) can be damaged electrically by incorrect handling. Read the following handling precautions before doing anything which involves detector element.

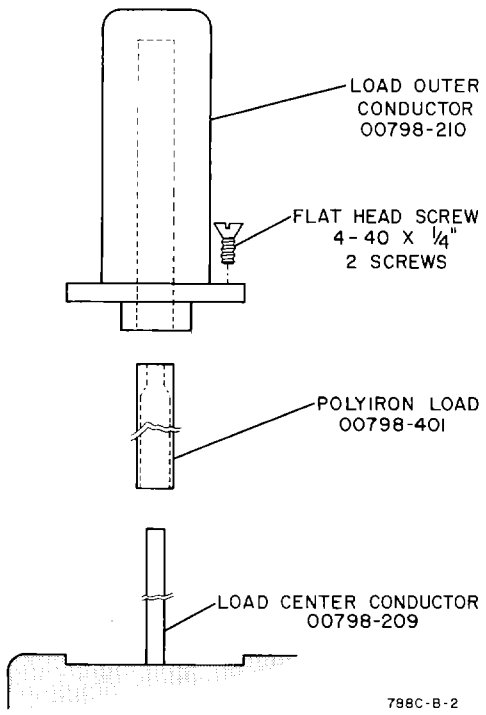


Figure 5. 788C Load Assembly

23. HANDLING PRECAUTIONS.

a. Before installing detector element in mount, touch exposed metal on mount with hand to discharge any static charge. Then insert detector element.

b. When handing crystal to another person, touch hands first to ensure there is no difference in static electrical potential between you.

c. Do not use an ohmmeter to measure forward- and back-resistance. The open-circuit voltages and short-circuit currents from the ohmmeter can damage detector element (diode).

24. PROCEDURE.

a. Note Figure 4 and remove connector cap from body. To remove connector cap, use gas pliers with nylon teeth or protect connector body with heavy paper or tape.

b. Remove old detector element.

c. Install replacement detector element; black resistive end goes into crystal mount (detector element is a snug fit but not a forced fit).

d. Replace connector cap and TIGHTEN FIRMLY.

Note

A resistor is included with each replacement detector element ordered by the -800 or -801 number given in Figure 4. The resistor is for use in 11523A Load Resistor and must be installed to retain proper square-law operation if the directional detector is equipped with this optional load.

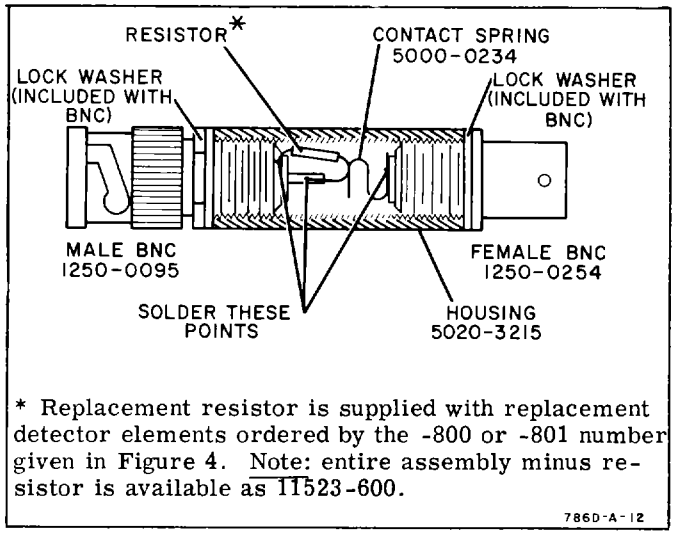


Figure 6. 11523A Cutaway View

25. DETECTOR BNC REPLACEMENT.

26. TOOLS REQUIRED.

a. Needle-point soldering iron.

b. Gas pliers with nylon teeth.

c. Male BNC mating connector.

d. Tweezers.

27. PROCEDURE.

a. Refer to Figure 4. Remove BNC connector and lockwasher.

b. Unsolder spring soldered to center conductor lead.

c. Slip spring over center conductor lead of new BNC and solder.

d. Let spring cool and then replace lockwasher and connector in connector cap.

28. 788C LOAD REPLACEMENT.

a. Refer to Figure 5. Remove two retaining screws and the load outer conductor.

b. Remove load and any loose or broken portions of the old load from inside the load outer conductor.

c. Replacement is the reverse of removal.

29. REPLACEMENT OF 11523A MALE BNC.

a. Refer to Figure 6. Unscrew male BNC and lockwasher from housing by using a 3/8-inch open-end wrench and holding housing either in a vise or with gas pliers.

Note

If gas pliers do not have nylon teeth, the housing should be protected.

b. Unsolder resistor.

c. Solder resistor to new BNC.

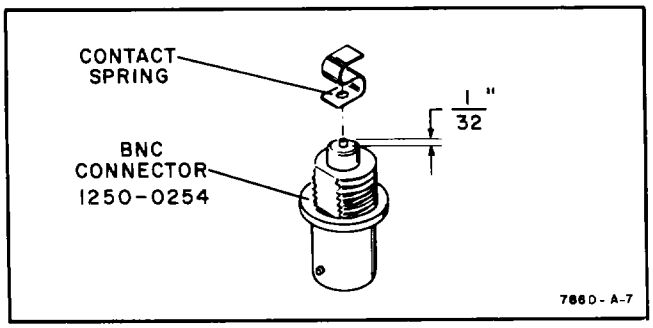


Figure 7. 11523A BNC Assembly

d. Let resistor cool, then check resistance from male BNC pin through resistor; resistance measured should be within 10% of that indicated by the coding.

e. Replace lockwasher and male BNC.

30. REPLACING 11523A FEMALE BNC.

a. Unscrew BNC with a BNC wrench or male BNC used as a wrench.

b. Unsolder contact spring.

c. Prepare replacement BNC connector:

(1) Cut center conductor lead to approximately 1/32 inch (refer to Figure 7).

(2) With flat file, smooth end of lead; wipe off burr with tweezers or similar metal instrument.

d. Slip contact spring over center conductor lead and solder.

CAUTION

Use solder sparingly or it will creep back on spring. Solder on spring destroys its usefulness and is difficult to remove.

e. Let contact spring cool and then screw BNC into housing.

31. PERFORMANCE CHECKS.

32. The performance check procedures given in Paragraphs 33 through 36 verify that the Directional Detector meets its specifications. Test equipment recommended for checking specifications is listed in Table 2. The critical specifications listed are the specific limitations an instrument type must meet and are not meant to be complete instrument specifications. Similar equipment having equal or better specifications than those listed may be substituted for the equipment listed. Test setups and instructions are given only for the 786D. Measurement techniques for the 787D and 788C are similar and differences in specification are mentioned where they exist.

33. FREQUENCY RESPONSE CHECK.

FREQUENCY RESPONSE: ±0.2 db (±0.3 db - 788C)

a. Set up test equipment as shown in Figure 8.

b. Set Sweep Oscillator for a leveled RF output.

c. Set RF output level for a convenient reference near full scale on Power Meter.

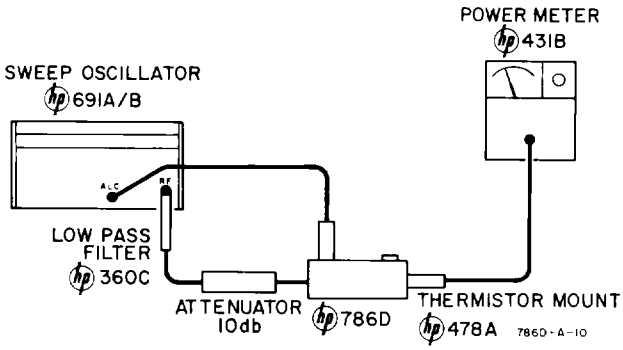


Figure 8. Frequency Response Check

d. Set Sweep Oscillator for 100-second sweep and note Power Meter indication. Specification: variation should not be greater than 0.4 db (0.6 db - 788C).

e. If variation exceeds 0.4 db (0.6 db - 788C), then a single frequency check must be made across the band. A method of checking at single frequencies across the band is to tune from point to point and compare main line RF output against auxiliary line output.

34. SENSITIVITY CHECK.

SENSITIVITY: 100 mv detected output for 35 mw (3.5 mw - 788C) RF output.

a. Set up test equipment as shown in Figure 8 with the following exceptions: the 10-db Pad should be connected between 786D and 478A and detected output connected to a DC Voltmeter through a BNC-to-binding post adapter.

CAUTION

An RF power level exceeding 10 mw will damage Thermistor Mount. Be careful not to exceed 10 mw to mount.

b. Starting at minimum, carefully increase CW-RF power to obtain a 100-mv reading on the DC Voltmeter. Specification: 35 mw (3.5 mw - 788C) or less (Power Meter reading plus attenuation of Attenuator) produces a 100-mv detected output.

c. Repeat above check at all points of interest across the band.

35. SWR CHECK.

MAIN LINE SWR: ≤1.15 (1.20 - 788C)

a. Set up test equipment as shown in Figure 9.

b. Set Sweep Oscillator for a single frequency, 1000-cps square-wave modulated RF output.

c. Adjust square-wave modulation frequency for optimum SWR Meter indication on 40-db NORMAL scale.

d. Phase Sliding Load to obtain minimum SWR scale indication.

e. Adjust Slotted Line carriage for minimum SWR-scale indication as near center of slotted section as possible. Repeat step d, if necessary.

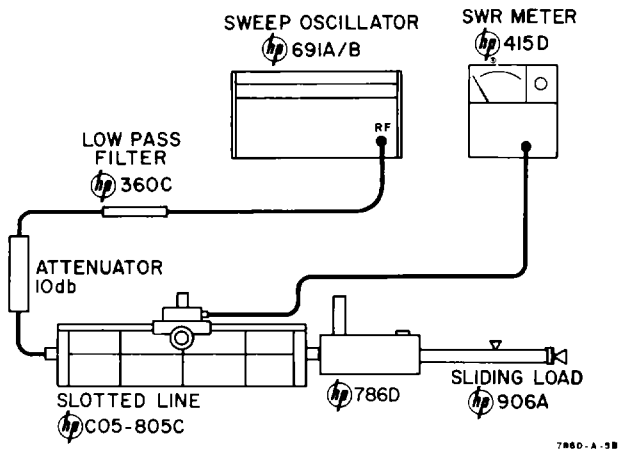


Figure 9. SWR Check

f. Set a 1.0 indication on SWR Meter SWR-EXPAND scale.

g. Adjust Slotted Line for a maximum SWR-scale indication.

h. Phase Sliding Load for a minimum reading and record. Specification: SWR reading must be equal to or less than 1.15 (1.20 - 788C).

36. DIRECTIVITY CHECK.

MINIMUM DIRECTIVITY: 30 db
(26 db - 787D; 20 db - 788C)

a. Set up equipment as shown in Figure 10.

b. Set Sweep Oscillator for leveled, square-wave modulated RF output.

c. Set 0-db reference on SWR Meter.

d. Remove Attenuator from setup.

e. Connect Sliding Load to male connector (786D under test) and using a female-to-female adapter connect 786D under test to 786D.

f. Set Sweep Oscillator for 100-second sweep rate.

g. Note SWR Meter indication and continuously phase Sliding Load. If both minimum and maximum indications are greater than the 0-db reference, the directional detector meets the directivity specification.

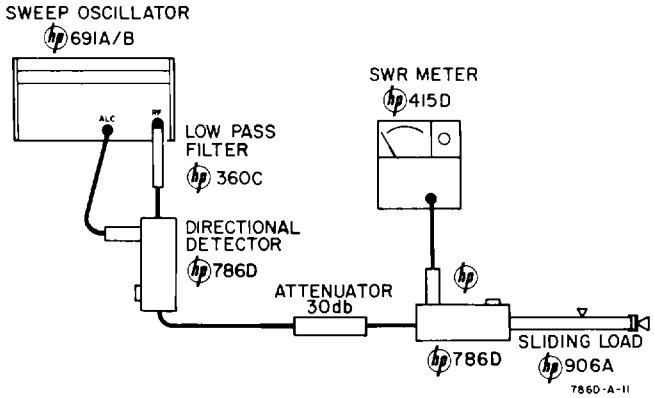


Figure 10. Directivity Check

However, these readings are uncorrected, smaller-than-actual-value readings.

h. To determine actual directivity first add attenuation of Attenuators used in step a to each reading made in step g; then subtract maximum from minimum readings and find difference value (M_1). For example, if readings were 0.5 and 5.4 db and assuming attenuation of Attenuators used is equal to 30 db, then the minimum is 30.5 db and the maximum is 35.4 db. The difference between the two readings is 4.9 db (which is M_1).

i. Refer to Figure 11. Determine values for M_2 which are the two correction factors to be used. Add the minimum reading of step g to each correction (M_2). For example, if the difference in db (M_1) is 4.9 db, then from the graph (Figure 11) the two corrections are 2.1 and 13.3 db. One corrected value is Sliding Load return loss and the other is 786D directivity.

j. To identify directivity reading, loosen Sliding Load center conductor lock and slightly loosen connection to 786D without rotating center conduction. Tighten lock.

k. Repeat steps d through i. The corrected value for Sliding Load return loss should remain practically the same as original corrected reading (within a few tenths of a db). The 786D directivity is the other original corrected reading.

m. The following is an example of measurement steps with actual readings and conclusions.

(1) SWR Meter readings were 0.5 and 5.4 db.

(2) The attenuators used were 20 db and 10 db; hence, the readings indicate 30.5 and 35.4 db.

(3) The difference between the minimum and maximum readings is then 4.9 db.

(4) Referring to Figure 11, the two correction factors are 2.1 and 13.3 db.

(5) The minimum reading (30.5 db) added to each results in two corrected readings: 32.6 and 43.8 db.

(6) To determine which reading represents the Sliding Load, the center conductor is partially unplugged from the 786D.

(7) The above steps were repeated which resulted in SWR Meter indications of 25.5 and 28.0 db. The difference between the two readings is 2.5 db which from Figure 11 determined the two correction factors to be 1.2 and 18.0 db.

(8) The two correction factors added to the 25.5 db minimum gave corrected readings of 26.7 and 43.5 db.

(9) The Sliding Load return loss was 43.5 to 43.8 db, because making a bad connection between the Sliding Load and the 786D did not affect this reading much.

(10) The 786D directivity was 32.6 db, because making a bad connection between the Sliding Load and the 786D did affect this reading causing an erroneous reading which did not agree with either of the previous corrected readings.

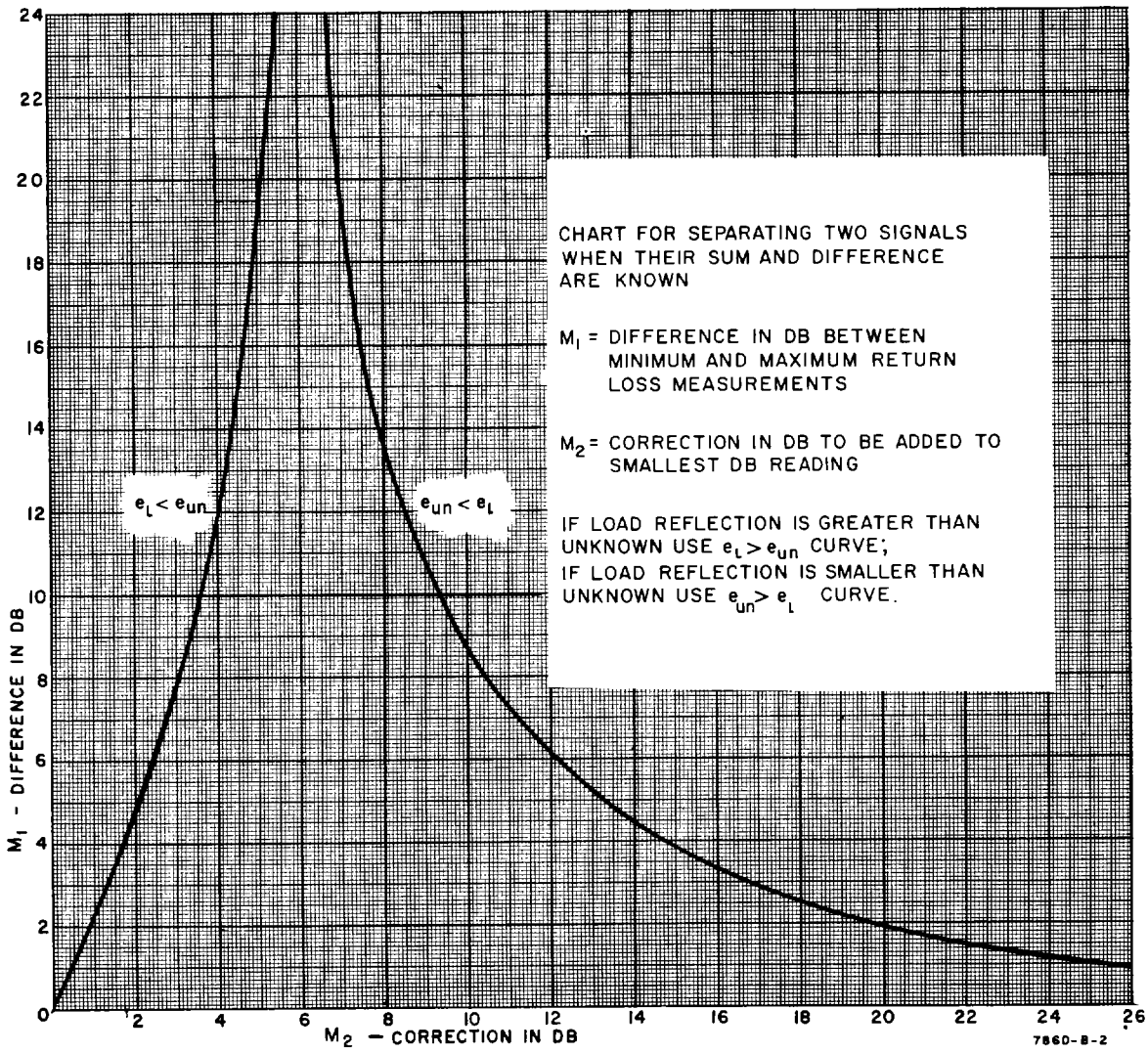


Figure 11. Signal Separation Chart

Table 2. Recommended Test Equipment

Instrument Type	Critical Specifications	Check	Model
Sweep Oscillator	Frequency Range: (directional detector) Power Output: 10 mw Leveled Capability*: ±0.1 db Residual FM: Less than 50 kc	All	691A/B (786D) H01-692A (787D) H01-693A (788C)
Low-Pass or Bandpass Filter	Frequency Range: (directional detector) Rejection: Not less than 40 db	All	360B (786D) 360C (787D & 786D) 360D (787D & 788C) 8435A (788C) 8436A (788C)
Power Meter and Thermistor Mount	Frequency Range: (directional detector) Power Range: -10 to +10 dbm Accuracy: ±3%	Frequency Response Sensitivity	431B (meter)and 478A (mount)
Fixed Attenuator	Frequency Range: (directional detector) Attenuation: 10 db	Frequency Response Sensitivity SWR	Weinschel 210-10
	Frequency Range: (directional detector) Attenuation: (directional detector directivity)	Directivity	Weinschel 210-10 (786D) 210-20 (all) 210-6 (787D)
DC Voltmeter	Range: 20 to 100 mv Input: 10 megohms Accuracy: ±2% of full scale	Sensitivity	410C
SWR Meter	Frequency: 1000 cps ±2% Calibration: Square Law Accuracy: ±0.05 db (on EXPAND scale) Input: 200K ohms	SWR Directivity	415B or 415D
Directional Detector	Frequency Range: (directional detector) Detected Output: Negative Sensitivity: 4 mv/mw Frequency Response: ±0.3 db	Directivity	786D (786D) 787D (787D) 788C (788C)
Sliding Load	Frequency Range: (directional detector) Connectors: Standard type N Residual SWR**: 1.05	SWR Directivity	906A
Slotted Line	Frequency Range: (directional detector) Connectors: Standard type N Residual SWR: 1.04	SWR	C05-805C (786D & 787D) C05-806B (788C) 809B (788C)

* Excluding coupler and detector variation (with the 786D the leveling capability would be ±0.3 db)

** Residual SWR: 1.10 from 1.0 to 1.5 Gc

WARRANTY CLAIM AND ADJUSTMENT PROCEDURE

for microwave tubes supplied by the
HEWLETT-PACKARD COMPANY
for use in Hewlett-Packard instruments

The procedure described below is for use within the United States. For warranty claims arising outside the U.S.A., before returning the tube, fill out the form on the reverse side and send it with a request for shipping instructions to your nearest Hewlett-Packard Sales and Service Office or to:

(in Western Europe)

Hewlett-Packard S.A.
54 Route des Acacias
Geneva, Switzerland
Telephone: (022) 42.81.50
Telex: 2.24.86
Cable: HEWPACKSA

(Rest of World)

Hewlett-Packard Co.
International Marketing Dept.
1501 Page Mill Road
Palo Alto, California, 94304, U.S.A.
Telephone: (415) 326-7000
Telex: 033811
Cable: HEWPACK

Microwave tubes supplied by the Hewlett-Packard Company, either as original or replacement, for use in Hewlett-Packard instruments are actually warranted by the tube manufacturer and not by Hewlett-Packard. However, all warranty claims on tubes obtained from us either as original or replacement will be processed by Hewlett-Packard.

In the event of failure you should purchase a new tube immediately without regard to first returning the defective tube to Hewlett-Packard because old tubes will not be repaired. Credit allowances will be passed on to you upon receipt of the defective tube.

For your convenience, warranty claims for all microwave tubes supplied by the Hewlett-Packard Company may be made on this single form; merely fill out the information on the reverse side and return this from, along with the defective tube, to your Hewlett-Packard Sales and Service Office or to Hewlett-Packard. Please be sure each space on the form is filled in--lack of complete information may delay processing of your claim.

Each tube manufacturer has his own warranty policy. Copies of individual Conditions of Warranty are available from your Hewlett-Packard Sales and Service Office or from the Hewlett-Packard Company.

SHIPPING INSTRUCTIONS

The following instructions are included to aid you in preventing damage in transit. Package your tube carefully--no allowance can be made on broken tubes.

1. Carefully wrap tube in 1/4-inch thick cellulosic cushioning, cotton batting, or other soft padding material. Cable assemblies and other accessories not rigidly mounted to the tube should be padded and wrapped separately to prevent damage to the tube during shipment.
2. Wrap the above in heavy kraft paper.
3. Pack in a rigid container which is at least 4 inches larger than the tube in each dimension.
4. Surround the tube with at least 2 inches of shock absorbing material. Be certain that the packing is tight all around the tube.
5. Tubes returned from outside the continental United States should be packed in a wooden box.
6. Mark container FRAGILE and ship prepaid via Air freight or Railway Express. Do not ship via Parcel Post or Air Parcel Post since experience has shown that fragile items are more apt to be damaged when shipped by these means.

Note

Tubes with permanent magnets can interfere with magnetic compasses.
For air shipment plainly mark container: "MAGNETIZED MATERIAL"

In warranty tubes purchased from Hewlett-Packard may be returned, with a completed warranty Claim Form, to your local Hewlett-Packard Sales and Service Office, or to:

Hewlett-Packard Company
Eastern Service Center
Green Pond Road
Rockaway, New Jersey, 07866
USA

Hewlett-Packard Company
Western Service Center
395 Page Mill Road
Palo Alto, California, 94306
USA

MICROWAVE TUBE WARRANTY CLAIM
INFORMATION FORM

IMPORTANT: Please answer all questions fully -- insufficient information may delay processing of your claim.

FROM: (Tube Owner)

Company _____

Address _____

_____

_____

Tube type _____

Tube serial No. _____

Tube mfr. _____

Use in ℌ Model _____

Instrument serial no. _____

Tube is Original ( ) or Replacement ( )

Date tube received _____

Date first tested _____

Date placed in service _____

Date of failure _____

Date _____

FOR FURTHER INFORMATION CONTACT:

Name _____

Title _____

Company _____

Address _____

_____

Tube purchased from _____

_____

On P. O. number _____

Hours use per day (average) _____

Number of days in service _____

Total hours filament operation _____

SYMPTOMS: (Please describe conditions prior to and at time of failure, along with description of tube's defect, if known) _____

_____

_____

_____

Were there other circuit component failures at time of failure? Which ones?

_____

_____

Signature _____

Title _____

10/15/62
01153-3

HEWLETT hp PACKARD

MANUAL CHANGES

RF UNITS
MODEL 8691A/8692A/8693A/8694A

Printed: Nov 1968

MAKE ALL CORRECTIONS IN THIS MANUAL ACCORDING TO ERRATA BELOW, THEN CHECK THE FOLLOWING TABLE FOR YOUR INSTRUMENT SERIAL PREFIX (3 DIGITS) OR SERIAL NUMBER (8 DIGITS) AND MAKE ANY LISTED CHANGE(S) IN THE MANUAL.

► NEW ITEM.

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES	SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
916-	1		

ERRATA: Page 2-9, Figure 2-6.
Change R45 to R16, R16 to R39, and R39 to 45.

Page 4-3/4-4, Figure 4-2.
Change factory selected values of *R13 from 5.11 K to 10 K and *R16 from 100 K to 196 K.

Change transistors Q1 and Q6, HP Part No. 1854-0079 to HP Part No. 1854-0232.

► Figure 4-2:
Relocate A1CR15 off A1 Board Assy and show A1CR15 anode connected to XA1 pin 5 and cathode connected to XA1 pin 2.

CHANGE 1: ► Figure 4-2 and Parts List:
Change capacitor A1C4, Fxd, .05 μF, HP Part No. 0150-0052 to Fxd, 10 μF, HP Part No. 0180-0089.

Change resistor A1R35, Fxd, 100 Ω, HP Part No. 0757-0401 to Fxd, 511 Ω, HP Part No. 0757-0416.

27 August 1969

Supplement A for 08691-90021

PRINTED IN U.S.A.